Government of Nepal

National Reconstruction Authority

Singhadurbar, Kathmandu

REPAIR AND RETROFITTING MANUAL For MASONRY STRUCTURE

For earthquake damaged houses that needs to be repaired and retrofitted under

HOUSING RECONSTRUCTION PROGRAMME

2017

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FOREWARD

I would sincerely like to congratulate everyone involved in the development of the "Repair and Retrofitting Manual for Masonry Structures" which has been published by the National Reconstruction Authority. This manual will support the implementation of the 100,000 NPRs retrofitting grant for partially damage houses that need seismic retrofitting under the GoN housing reconstruction programme.

Thirty-one districts have been identified by the GoN Post Disaster Needs Assessment (PDNA) as being earthquake affected. To date, almost 25,000 households across these districts have been identified as eligible to receive the 100,000 NPRs housing retrofit grant. The grant will be disbursed in two tranches based on compliant construction.

Every effort is required to support households to retrofit unsafe structures so that they can receive the grant amount. This manual has been developed for technical staff to support them to guide households through the retrofit process, and to manage the inspections of completed retrofits.

I look forward to seeing the manual implemented across the earthquake affected districts and to seeing the impact that it will have. This represents another positive step forward in the reconstruction process, and will support households to retrofit their home so that it is safe, compliant, and resilient in the face of future disasters.

Dr. Govind Raj Pokharel
Chief Executive Officer, NRA

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PREFACE

Under the housing reconstruction programme, houses that are partially damaged, and fall under damage grade 2 (major) and 3 (minor) are eligible to receive a 100,000 NPRs grant to retrofit their home. For the household to receive the housing retrofit grant, their home must comply with all the specifications detailed in the inspection check sheet, which were formulated based on the Minimum Requirements (MRs). This manual has been prepared to introduce the inspection standards for the housing retrofit grant, and their associated step by step procedures for construction.

This manual will be used by all the engineers who are working for the reconstruction, and have been deployed by the GoN to carry out inspections.

The manual has been divided into four parts and two annexes:

PART- A: Seismic damage and intervention
PART- B: Seismic deficiencies and intervention
PART- C: Ready to use seismic retrofit designs
PART- D: Construction Sequences
Annex 1: Typical structural drawings
Annex 2: Annex 2 : EMS Damage Grade

Dr. Hari Ram Parajuli
Executive member, NRA

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Standardization Committee, NRA
for Reconstruction of Earthquake Resistant Houses

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We also thank senior structural engineers Er. Hima Gurubacharya, Er. Rajani Prajapati, Er. Kuber Bogati and Er. Kirty Tiwari for their continuous work during the preparation of this manual. Also thanks to Chandan Ranamagar and Rachana Kansakar for preparing the graphics and drawings respectively. Thanks to Ar. Sabika Mastran, Ar. Ambu Chaudhary, Er. Siobhan Kennedy, Er. Jyotimani Bhattarai and Er. Nabin Paudel.

We appreciate Partner Organisations' (POs) work to review and contribute to the draft manual, especially Build Change, Catholic Relief Services, World vision Nepal, and so on .

We would like to congratulate all personnel involved, both directly and indirectly, for their valuable contribution to the preparation of this manual.

Standardization Committee, NRA
for Reconstruction of Earthquake Resistant Houses

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PART-B: Seismic Deficiencies and Intervention

Contents

PART-C: Ready to use seismic retrofit designs

PART-D: Construction sequences

Annex 1 : Typical structural drawing

Annex 2 : EMS Damage Grade

BACKGROUND

The damage assessment carried out by the NRA and the Central Bureau of Statistics (CBS) categorised damaged houses by damage grade and technical solution. Almost 25,000 households across the 31 earthquake affected districts were categorised as damage grade 2 and major technical solution or damage grade 3 and minor technical solution. Under the Government of Nepal (GoN) housing reconstruction programme, a housing retrofit grant of 100,000 NPRs will be available to these households if their retrofit complies with the relevant standards and specifications.

This manual outlines these standards and specifications as well as the minimum intervention works required to carry out the retrofitting.

The manual discusses two levels of intervention works which are necessary for damaged buildings and that ensure a life safety level of performance under the standards set out in the Nepal National Building Code, NBC 105: 1994.

There are various methods of repair and retrofitting for earthquake damaged masonry structures in different categories. Where repair methods are applied it is expected that the structure will be restroed to its pre-earthquake condition, whereas the application of retrofitting methods is expected to increase the strength and ductility of the structure beyond its original condition. This manual incorporates repair and retrofit methods considering their suitability in terms of material availability, affordability, and ease of construction.

This manual has been developed to support the engineers responsible for the compliance inspection process. The engineers will use this manual to provide advice and guidance to households for the implementation of required repair and retrofitting strategies.

Objectives of this manual:

- To set the minimum criteria to provide the tranches under the retrofitting grant
- Cover policies for distribution of tranches with minimum technical intervention options (economical and 31 district orientated.)
- References are taken from published documents and recent researches
- To support engineers for inspection, help them to provide advice and guidance to households

Repair and retrofitting works, carried out using approved and published GoN documents, are also considered as a part of this manual.

SCOPE

❑ Applicability

The repair and retrofitting strategies set forth in this manual are applicable only for residential houses categorised as damage grade 2 (major) or 3 (minor) after Gorkha earthquake 2015 under the GoN housing reconstruction programme. The manual intends to achieve the minimum acceptable structural safety envisioned in NBC 105: 1994 after completing two levels of intervention.
The designs mentioned in the manual are ready-to-use designs for all structural components, but some provisions mentioned are set as advisory measures.

❑ Limitations

The repair and retrofitting strategies are only for damaged non-engineered residential buildings.

This manual has certain limitations and is only relevant for buildings which are:

I. Residential and fall under category 'C' and 'D' of NBC.

- ✓ Category "A": Modern building to be built, based on the international state-of-the-art, also in pursuance of the building codes to be followed in developed countries.
- ✓ Category "B": Buildings with plinth area of more than One Thousand square feet, with more than three floors including the ground floor or with structural span of more than 4.5 meters.
- ✓ Category "C": Buildings with plinth area of up to One Thousand square feet, with up to three floors including the ground floor or with structural span of up to 4.5 meters.
- ✓ Category "D": Small houses, sheds made of baked or unbaked brick, stone, clay, bamboo, grass etc., except those set forth in clauses (a), (b) and (c).

** If the intervention has already been completed as per, or similar to, the strategies outlined in this manual, Government of Nepal published documents, or as per international practices, and are based on codal provision ensuring life safety with quality construction, then applications can be forwarded only after thorough engineering judgement*

Few definition

Seismic Damage

According to post earthquake damage assessment carried out as per EMS 98 scale, level of damages found in masonry buildings are of grade 1 to grade 5 (refer annex 2). The structural components which helps in smooth transmit of loads in masonry building are (i) foundation, (ii) structural masonry walls, (iii) roof/floor and (iv) connections (are vital which maintains integrity of the structural systems) where as remaining components such (i) partition walls, (ii) gable walls, (iii) Chimney, (iv) false ceiling, (v) decorative components etc. are non-structural components of the building. The damages in structural and non-structural components of buildings due to earthquake are seismic damage. Repair shall be done to the non-structural components against damage and retrofitting shall be done to the structural components against damage.

Seismic Deficiencies

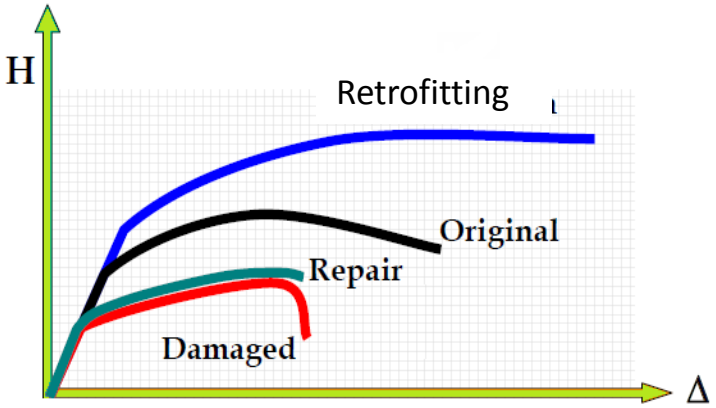
Building system, configuration, lateral force resisting system are basic vulnerability factors to the seismic performance to the building in future earthquake. Retrofitting can be done to overcome seismic deficiencies of buildings. The masonry buildings which are partially damaged due to Gorkha earthquake, which comes under DG2-major and DG3-minor and are eligible to get housing grant under “repair and retrofit” category shall have life safety level of performance envisioned by NBC 105:1994 to complete the tranches.

Intervention works

Repair and retrofitting are intervention works in seismic damaged or capacity deficient structures:

- **Repair** : Repair does not improve the structural strength of the building and very deceptive for meeting the strength requirements of the next earthquake.

- **Retrofitting :** This removes the seismic deficiencies and improves the response of existing un-reinforced masonry buildings to both gravity and seismic loads it improves the “box type” behavior and increases the flexural strength of un-reinforced walls and piers. Improvement in configuration, load path, redundancy, connections, ductility and capacity etc falls under this.



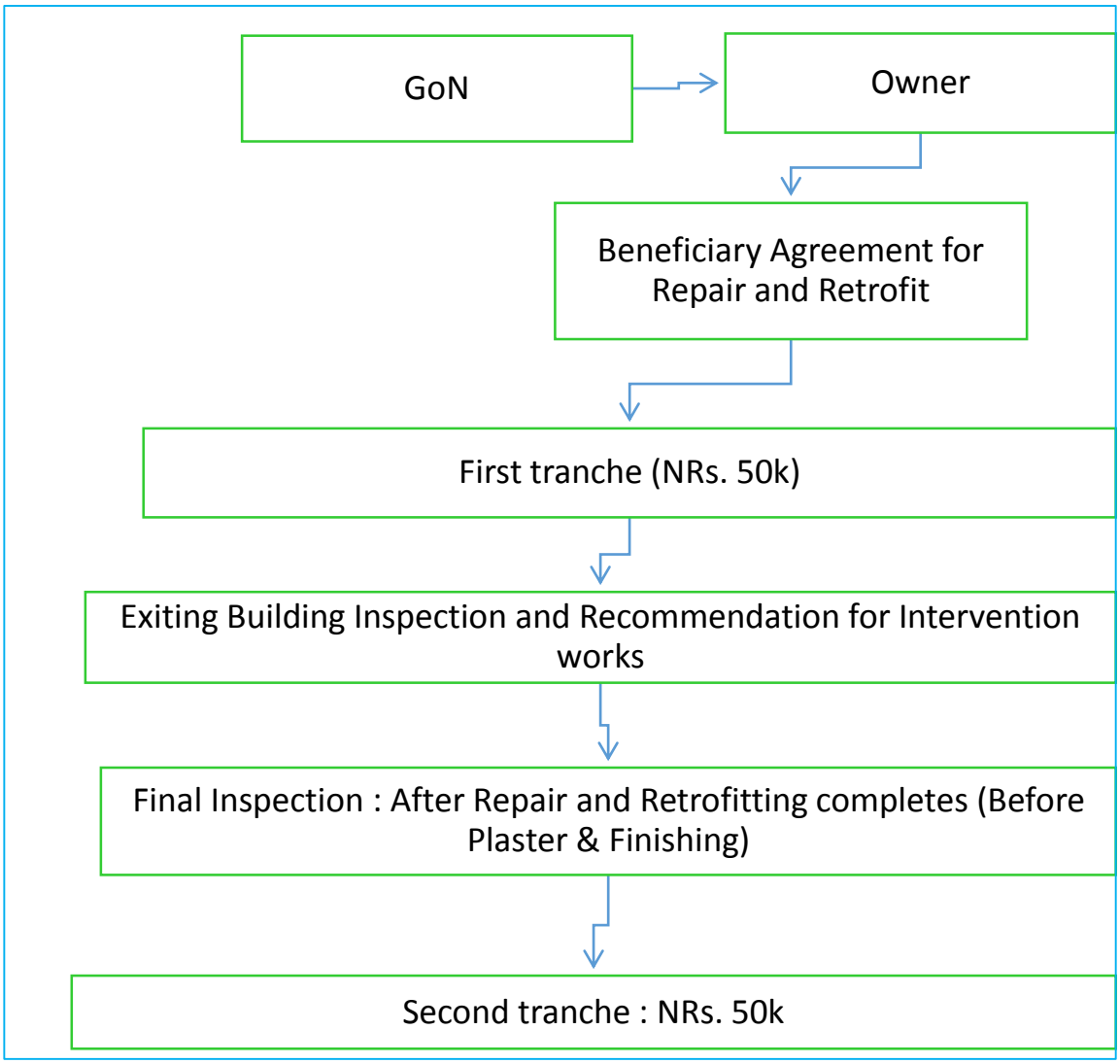
Comparison of Repair/Retrofitting

Level of Intervention

Level of Interventions required to receive the grant:

This guideline presents repair and retrofitting methodologies for stone masonry and brick masonry buildings. For retrofitting, it consists of retrofitting design and outcomes of the sample buildings taken from the earthquake effected areas. Also for those building which can be modified to match with sample buildings, modification methodologies are given. For those buildings which are not within the scope of the manual (such as span restrictions, height restrictions, number of storey etc.), this manual is not applicable however, grant will be given if detail retrofit analysis and design is carried out.

Grant distribution process:



Flow chart of Grant Distribution of Repair and Retrofitting

PART-A: Seismic damage and intervention

This part deals with seismic damages and possible intervention that needs to turn the building in to pre-earthquake condition.

1. Foundation damage and mitigation work

[Key Problem]
Potential damages in foundation are as follows :
F.1 Cracked stone masonry
F.2 Settlement of Foundation
F.3 Bulged Stone Walls
F.4 Dislocations and Loose Stone
F.5 Stone foundation wall interruption, removal of portions of the wall, & loss of structural integrity

[Repair Solution]
Repair solution on corresponding damages in foundation listed above, are :
F.1 For Minor cracks : action #01
F.2 Settlement of Foundation :May be possible with grouting if it is only minor to moderate crack (Action #04), Else more soil intervention may require
F.3 Bulged Stone Walls : action #04
F.4 Dislocations and Loose Stone : Action #04
F.5 Stone foundation wall interruption, removal of portions of the wall & loss of structural integrity : Action #04

[Retrofitting Solution]
FR.1 Foundation improvements : if the existing foundation size is not sufficient then improvement in foundation is required, else repair or restore of damaged works as above is sufficient. Foundation improvement can be done as explained (Refer part B).

[Note] : Level/extent of damage can be quantify on the basis of post earthquake damage assignment knowledge and appropriate repair/retrofit solution can be recommended accordingly.

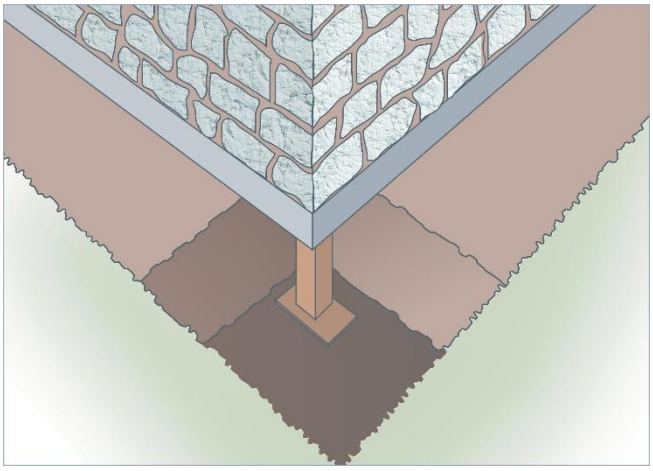
1.1 Foundation Damage and mitigation work

Problem

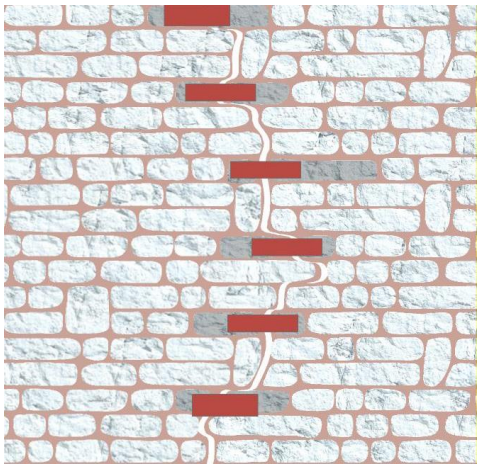
F.3 Bulged and leaning stone Foundation

F.2Settlement of Foundation

Solution: Repair works



Reconstruction of Foundation with proper safety



Repair Foundation

Note : Provide sufficient props and temporary support, reconstruct the wall footing as new. Also, increase soil bearing capacity or provide additional retaining structures if needed.

Note : Depending upon size of cracks, apply appropriate solution discussed on part B1. Also ensure the sufficiency of foundation size, if yes, then no improvement is required in foundation.

2. Roof/floor partial collapse and mitigation works

[Key Problem]
Potential damages in floor and/or roof are as follows :
R.1 : Partial to heavy damage on gable wall
R.2 : Sliding of roof materials (stone slate or clay tiles)
R.3 : Roof connections failure
R.4 : Floor connection
R.5 : Floor to wall connection
R.6 : Roof to wall connection
R.7 :Wall to wall connection

[Repair Solution]
Repair solution on corresponding damages in floor and/or listed above, are :
R.1 : Remove heavy material replace with lighter materials
R.2.: Replace damaged tiles and anchor all the tiles
R.3: Provide new appropriate roof/floor connection

[Retrofit Solution]
F(RF).2 Improve Roof-to-Wall connection, Floor-to-Wall connection, improve connections in Roof/Floor (stiffening the Roof/Floor), provide bracing at Roof/Floor. Improvements are described in part B.

R1.Partial to heavy damage of Gable wall

Problem : Gable wall collapse

R1.1 Gable wall toppling

R.1.2 Gable wall toppling

Solution : Remove heavy material replace with the lighter materials

Use of C.G.I. sheet at
Gable part

Use of timber planks at
Gable part

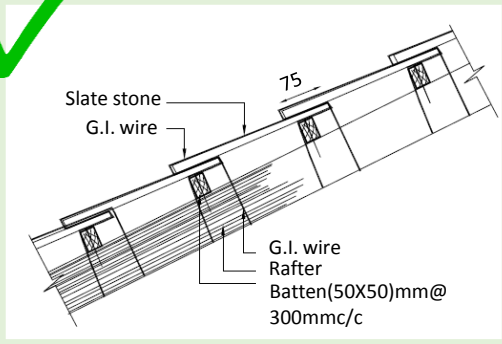
Problem : Sliding of roof tiles (stone slate or clay tiles)

R.2.1 Slate stone roof

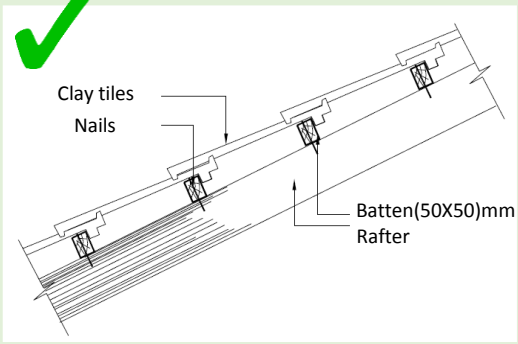
R.2.2 Clay tile roof

Solution

- Replace damaged tiles.
- Using appropriate correct fixing method for roofing materials.
- Connect the roof with the roof band by inserting reinforcement or GI sheet.
- Slatestone and clay tiles should be properly anchored to purlin as NBC.

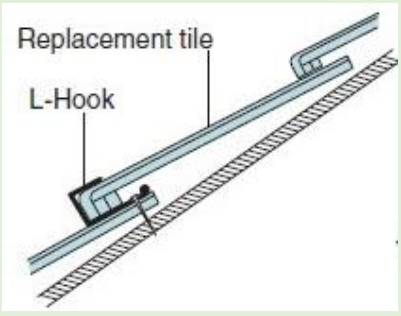


Detail of anchoring slate stone
Source: NBC203 2015, P44

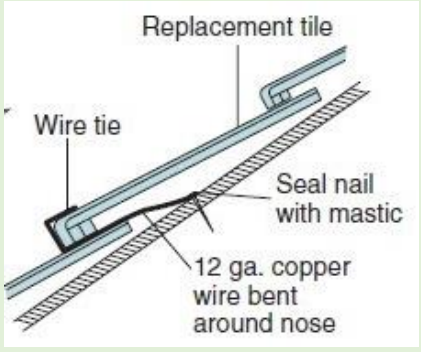


Detail of fixing clay tile
Source: NBC203 2015, P45

L-hooks



Wire ties



Gently lift the overlapping tile and twist loose the damaged tile.
After filling any nail holes, slip in a new tile and secure with an L-hooks (left) or bent copper wire (right)

Problem : Inadequate roof connections or connections failure

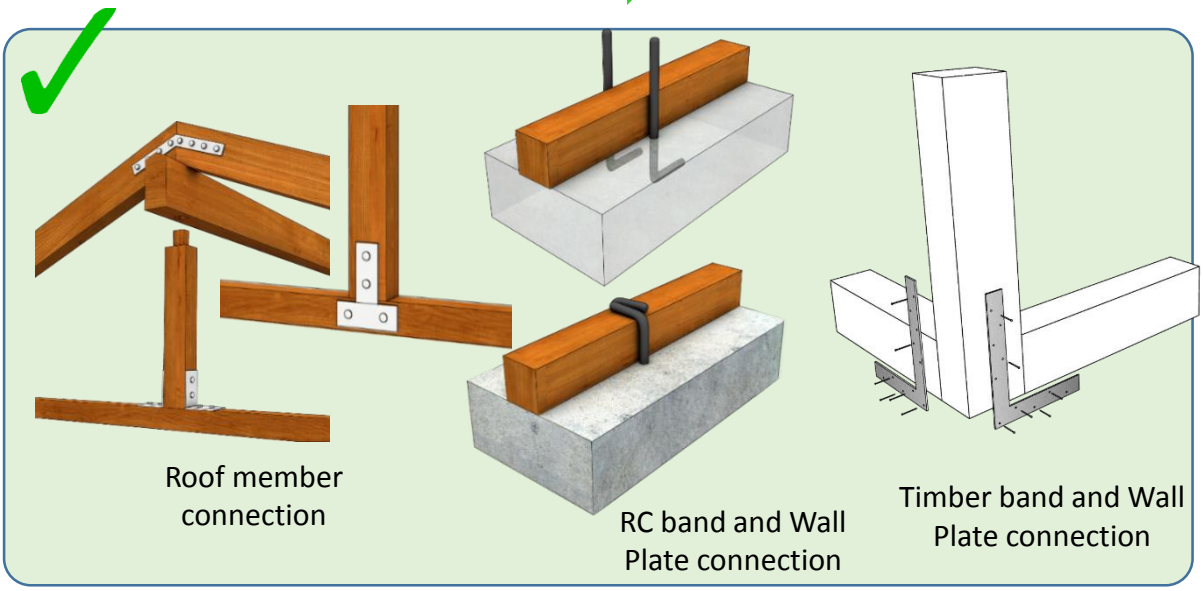
R.3.1 Purlin detached from rafter due to inadequate nailing

R.3.2 Connection of wooden truss

Solution

- Use a continuous wall plate, ridge and purlins to tie the rafters or trusses together.
- Stiffening of roof
  - Diagonal straps with steel nut bolts or metal nails
  - Diagonal steel truss with steel nut bolts or metal nails
  - Timber bracing with metal nails or timber nails

Refer Part B



Problem :Roof/floor bracing missing

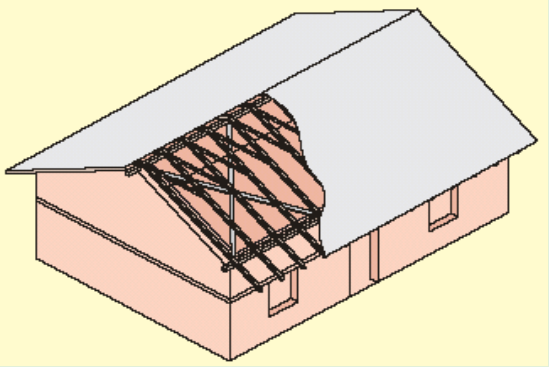
R.3.3 Bracing missing in inclined roof

Refer Part B

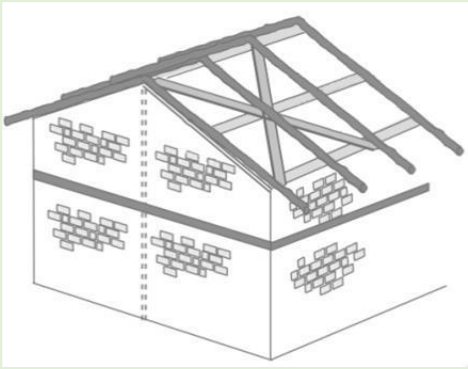
Solution

- Provide X-bracing at end bays on each sloppy side
- Provide additional roof/floor member as needed

Diagonal Bracing to roof



Stiffening of the floor with diagonal timber planks



Diagonal Steel bracing to roof

Steel bracing to roof

Flexible diaphragm improvements

Problem : Inadequate roof connections or connections failure

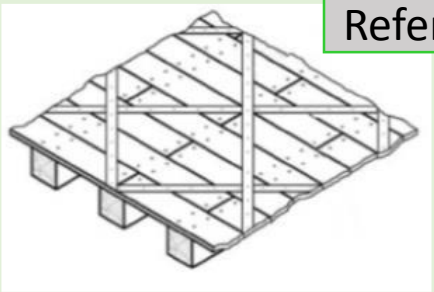
R.4.1 view inside the attic showing the rafters and the absence of collar beams and joist connections to the rafters

R.4.2 Inadequate and poor floor members

Solution

- Use a continuous wall plate, ridge and purlins to tie the rafters or trusses together.
- Stiffening of roof
  - Plywood overlay
  - Diagonal straps
  - Nailed sheeting
  - Concrete overlay
  - Plank overlay
  - Diagonal steel truss
  - Timber bracing
  - New RC floor

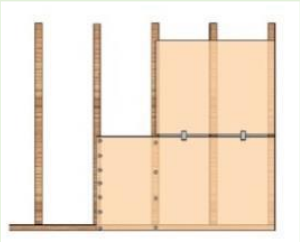
Diagonal straps



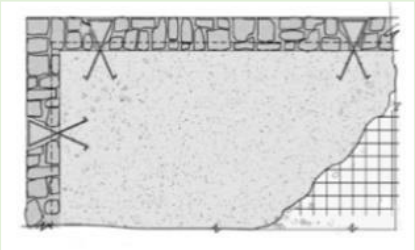
Refer Part B

Connectivity of roof member

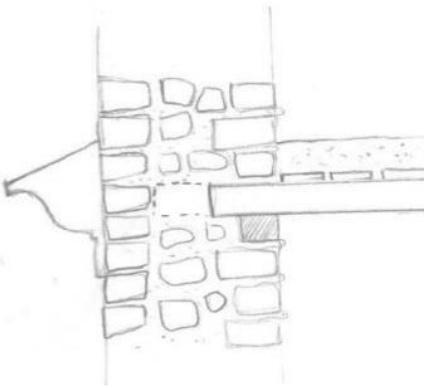
Nailed sheeting



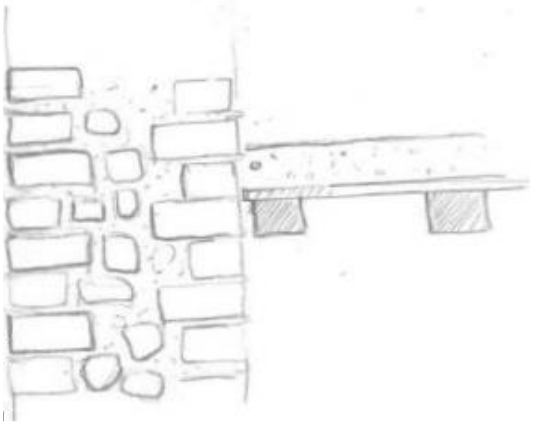
New RC Floor



Problem : Inadequate roof connections or connections failure



R.5.1 Floor joists supported by half of the wall width (insufficient anchorage)



R.5.2Wall-to-floor connection *parallel to the joists (insufficient anchorage)*

Solution

Steel Strap

Anchored with splint and bandage at floor level

Timber block

Refer Part B

Problem : Inadequate roof connections or connections failure

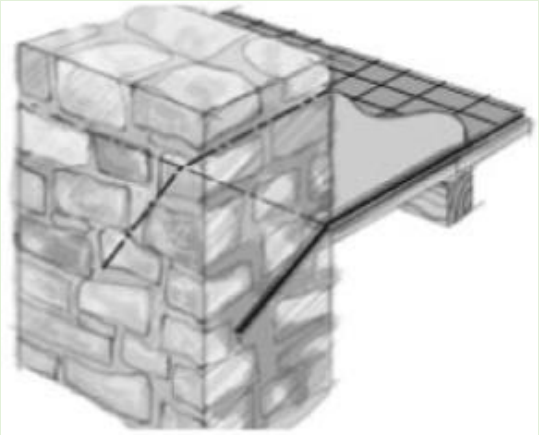
R.6.1 Damaged buildings showing wall-to-floor(joist) connection in Bungamati

Solution

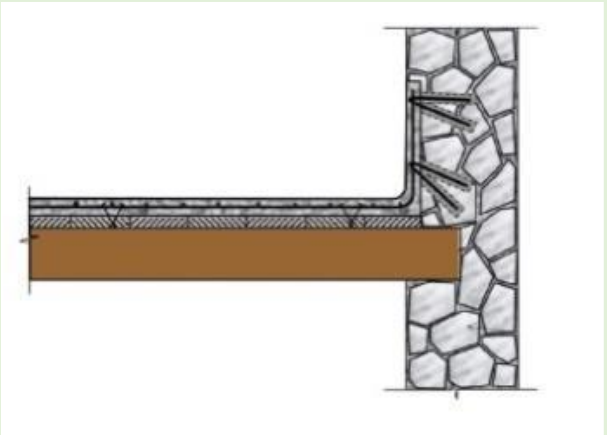
- Anchors ties
  - Anchor to joist
  - Wall anchors
  - Connector element
  - Combined methods

Refer Part B

Anchor inlay into wall



Anchors in wall fold overlay



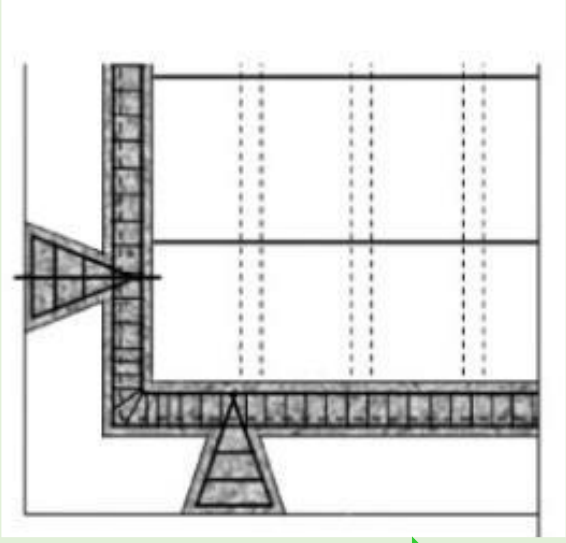
Problem : Inadequate roof connections or connections failure

Solution

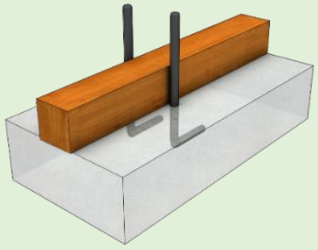
- Use a continuous wall plate, ridge and purlins to tie the rafters or trusses together.

✓

RC-diaphragm chord with shear locks



Anchor joist with rebars embedded in roof band



Refer Part B

3. Cracks in wall and mitigation works

Seismic damage pattern

Potential damages in structural and non-structural wall are as follows :

C.1 : Minor cracks

C.2 : Major cracks

C.3 : Heavy cracks

C.4 : Out-of-plane failure of walls

C.5 : Wall to wall connection

Repair Solution

Repair solution on corresponding damages in wall listed above, are described in repair mitigation part D (D.1). From repair mitigation, apply appropriate options depending upon extend of damage.

Retrofit Solution

R.C.1. : For improvement in capacity of wall, retrofitting options are described in retrofitting Part-C and Part D (D.1) . Relevant options can be selected and apply in the building according to building typologies

Common types of earthquake induced damages in masonry building

Problem :

Diagonal Cracks:
Diagonal cracks on the walls are the result of in plane bending and shear force. When the in plane bending and shear capacity of the walls are exceeded, such diagonal X cracks are formed.

Corner Separation:
The lack of proper connection between the orthogonal walls result in Corner separation

Failure of Gable wall:
Lack of proper anchorage of gable wall with the roof results into failure of gable wall. This is the most common type of failure pattern in masonry buildings.

Problem :

Delamination:
Stone masonry walls have two exterior vertical layers (called wythes) of large stones, filled in between with loose stone rubble and mud mortar. There is no any connection between the two wythes of the wall. This causes bulging/separation of walls in the horizontal direction into two distinct wythes during earthquake. Delamination is very common in stone in mud buildings

Collapse of wall:
When the out of plane bending capacity of wall is exceeded, partial or complete collapse of wall happens.

Diaphragm failure:
Lack of proper connection of diaphragm: floor/ roof with the wall result in failure of floor/ roof.
Also Inadequate size of column and beam

Problem : Minor In-Plane Cracks in the building

C1.1 Low strength masonry : Stone Masonry in Mud mortar

C.1.2 Low strength masonry : Brick masonry in mud mortar

C.1.3 Brick masonry in cement mortar

Definition of Damage

Damage Grade	Damage level	Description of damage
DG1	Slight damage	Hairline cracks

Repair and Retrofitting

Repair Solution

- Pressure injection of cement grout or mixture of cement and mud : or Action #1

Problem : Moderate In-Plane Cracks in the building

C2.1 Low strength masonry : Stone Masonry in Mud mortar

C.2.2 Low strength masonry : Brick masonry in mud mortar

C2.3 Brick masonry in cement mortar

Definition of Damage

Damage Grade	Damage level	Description of damage
DG2	Moderate damage	Cracks up to 5 mm wide

Repair and Retrofitting

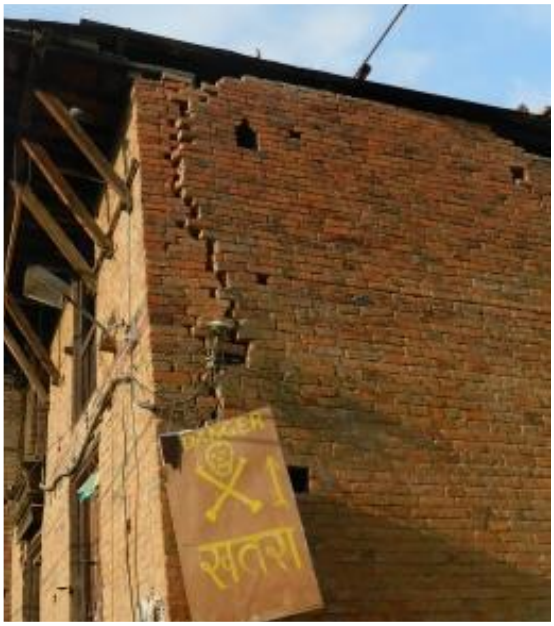
Repair Solution

- Grouting : Action #1
- Stitching

Problem : Heavy In-Plane Cracks in the building

C.3.1 Low strength masonry : Stone Masonry in Mud mortar

C.3.2 Low strength masonry : Brick masonry in mud mortar



C.3.3Brick masonry in cement mortar

Definition of Damage

Damage Grade	Damage level	Description of damage
DG3	Heavy damage	Cracks greater than 5 mm wide or wall material dislodge

Repair and Retrofitting

Repair Solution

- Through stones and Cement grouting in cracks : Action #4
- Rebuilt the portion of wall or wall cracked

Problem : Wall-wythes separation

C.4.1 Low strength masonry : SMM

C.4.2 Low strength masonry : BMM

Solution

- Rebuilding / wall overlay
- Through wall-anchors

Problem : Corner separation

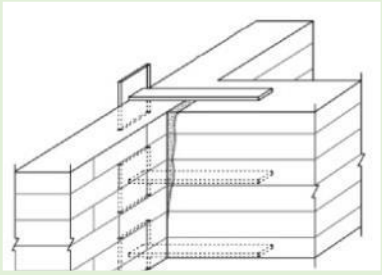
R.7.1 Low strength masonry : SMC

R.7.2Low strength masonry : SMM

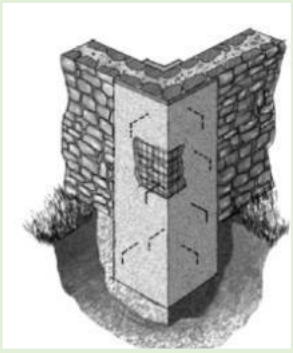
Solution

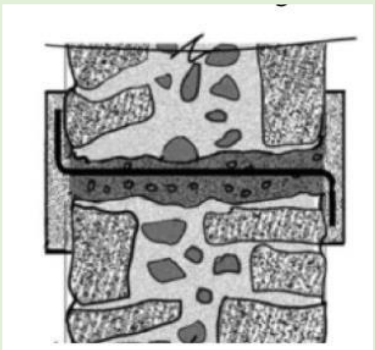
- Provide additional stiches

Metal stitching

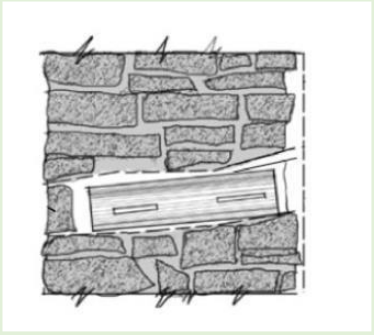


Anchored splint overlay





Through wall anchor



Through wall anchor

PART-B : Seismic deficiencies and intervention

Additional intervention may required with respect to inherent structural deficiencies after turning the building in to pre earthquake condition as per part A. This part deals with possible deficiencies in the masonry buildings and possible improvement measures. Probable intervention are as follows:

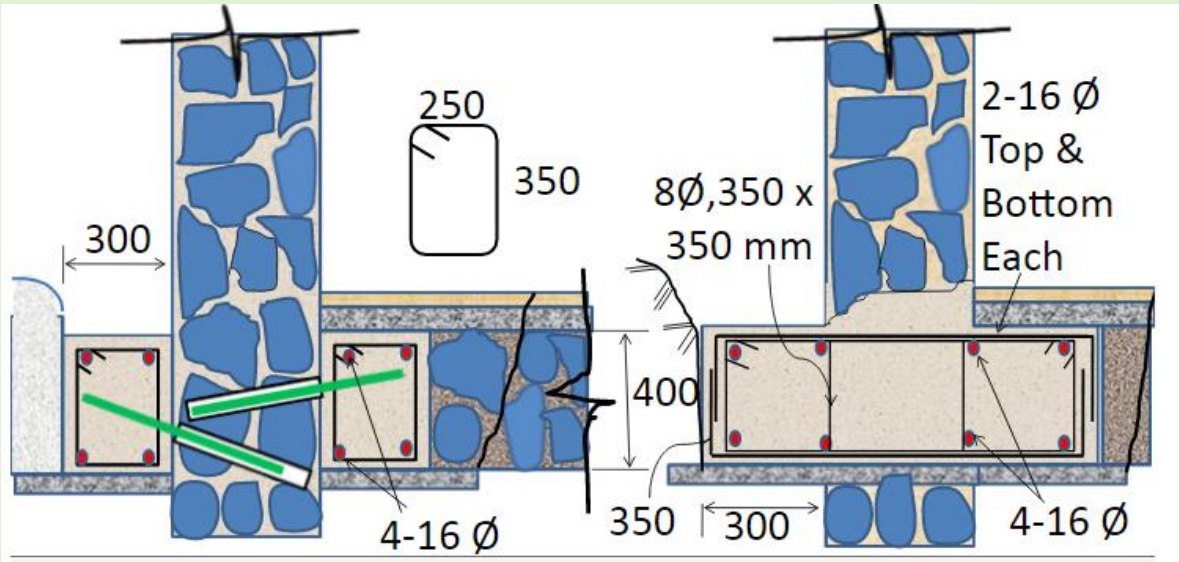
1) Foundation improvement
2) Configuration and load path improvement
3) Connection improvement between wall to wall
4) Connection improvement between wall to floor
5) Connection improvement between wall to roof
6) Stiffening of floor in their plane
7) Stiffening of roof in their plane
8) Tying of parapet wall
9) Tying of gable wall
10) Capacity improvement of structural wall with splint and bandage using:

Option	**For preventing global failure (Splint & bandage)**	**For present local failure control (to avoid effects due to lack of through stone etc.)**	**Remarks**
01	Welded GI wire mesh	GI wires in remaining part	**The following chapter covers brief about sketches and drawings which are informative only. For more details and clarity, refer annex 1 (separate volume in A3 paper sheets).**
02	GI wire mesh	PP band in remaining part	
03	Wooden section	GI wires in remaining part	
04	RCC	GI wires in remaining part	

General :

- Measures regarding strengthening of foundations are usually taken as part of seismic retrofit of a building. Geotechnical advice is required and specialized solutions in cases where masonry building has been damaged due to soil failure.
- In cases where no soil failure was observed foundations still may need to be strengthened when introducing new vertical structural members like tie-columns or shear walls.
- Interventions to the foundation system are also required due to deterioration of structural materials with time as well as improve the integrity of the building.
- Existing old masonry buildings are often without no or insufficient foundations. The vertical loads are transferred to the soil directly through the basement wall or foundation. In such cases construction of RC strip foundations under the basement walls can be applied. Depending on access limitations or ownership boundaries, the new strip foundations can be constructed by stitching to the sides of the existing walls or foundations.
- Before strengthening the existing foundations, the walls are first consolidated by grouting (cement or soil or stabilized soil.

To avoid disturbance to the integrity of the existing wall, during the foundation strengthening process, proper investigation & design is necessary



Refer : Schematic view of foundation strengthening with RC :

Problem

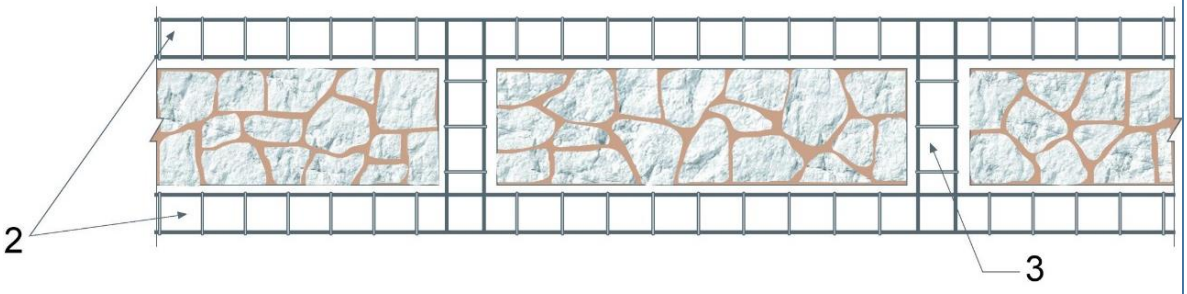
No foundation

Insufficient foundation

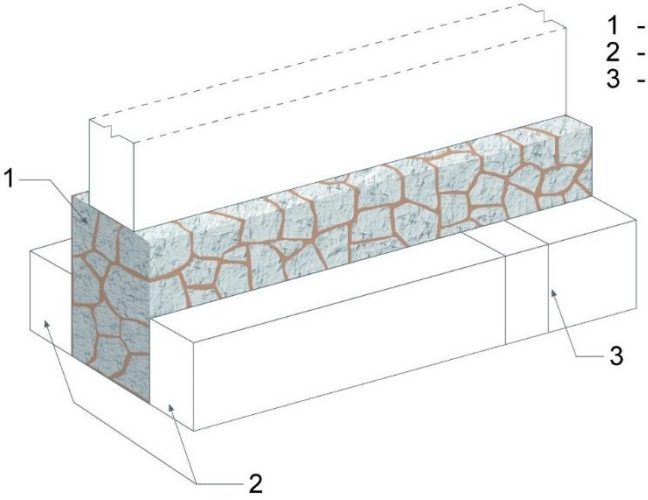
Solution

Addition of RCC foundation beam with proper connection

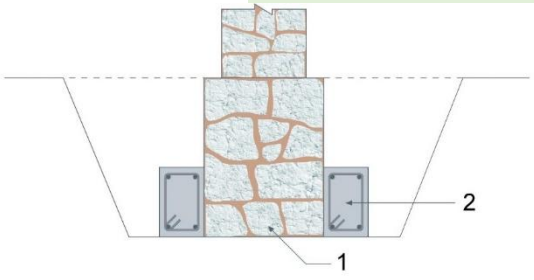
Schematic view of foundation strengthening with RC :



Horizontal section of wall through new RC beams



1 - Old foundation
2 - New concrete beams
3 - Connecting lateral concrete beams



Vertical section of wall I-I

Configuration :
The configuration of a building will influence the seismic performance of a building, particularly regarding the distribution of the seismic loads.

Architectural configuration : related to geometry, shape and size of building.

- The building shall be in rectangular in plan shape, ratio of maximum dimension to minimum dimension is three (3), in other case provide seismic gap.
- The projected length up to (one fifth : 1/5) of building length is acceptable.
- For small residential buildings not exceeding 100 sq.m. in plinth area with flexible floor and cross walls, the shape criterion of building can be ignored.
- The cantilever-projection of roof/floor, where provided, is acceptable but load bearing wall shall be replaced with lighter material over such cantilever-projections.
- If the load bearing wall continues from ground floor to first floor on the same vertical line, vertical setback is allowable.
- The maximum storey of building is two plus attic.

Structural configuration : related to size and location of structural members in the building

- Number of wall : there shall be two wall in each direction or equivalent system.
- Minimum wall thickness : equal or more than 230mm and 350mm for stone and brick respectively.
- Clear span of un supported wall : The span of wall up to 12 times of wall thickness is acceptable in one direction, in case where wall thickness is more than 350mm. Else, new wall or buttress walls should be constructed.
- Size of room : The size of room is restricted to 13.5 sq.m only for those houses with RCC slab. The thickness of RCC slab should be 115mm -125mm
- Height of wall : The height to wall thickness ratio of a wall shall not be more than 1:8 for stone masonry and 1:12 for brick masonry.

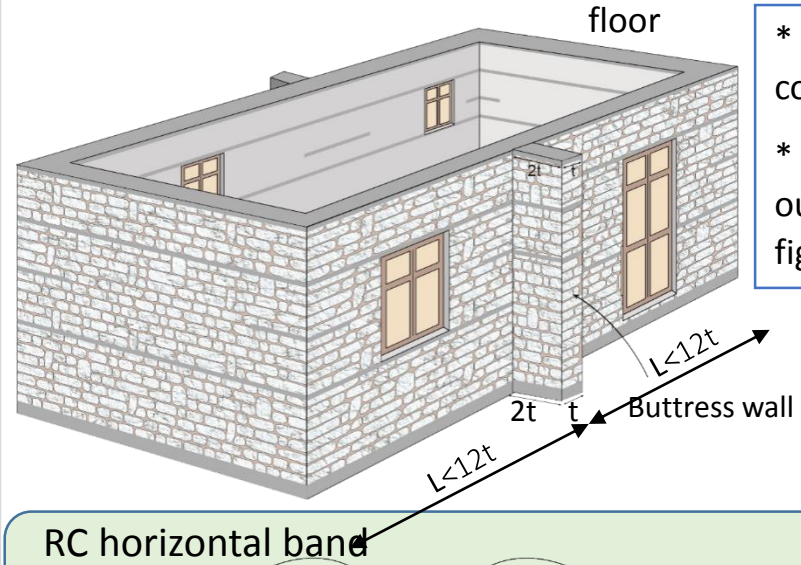
Load Path :

The structure shall contain at least one rational and complete load path for seismic forces from any horizontal direction so that they can transfer all inertial forces in the building to the foundation.

- To improve load path, size of opening can be reduced or closed with proper connection between new and old walling materials.

2.1 Configuration and load path improvement…

Example 1 : Construction details of Buttressing in mud mortar with flexible floor

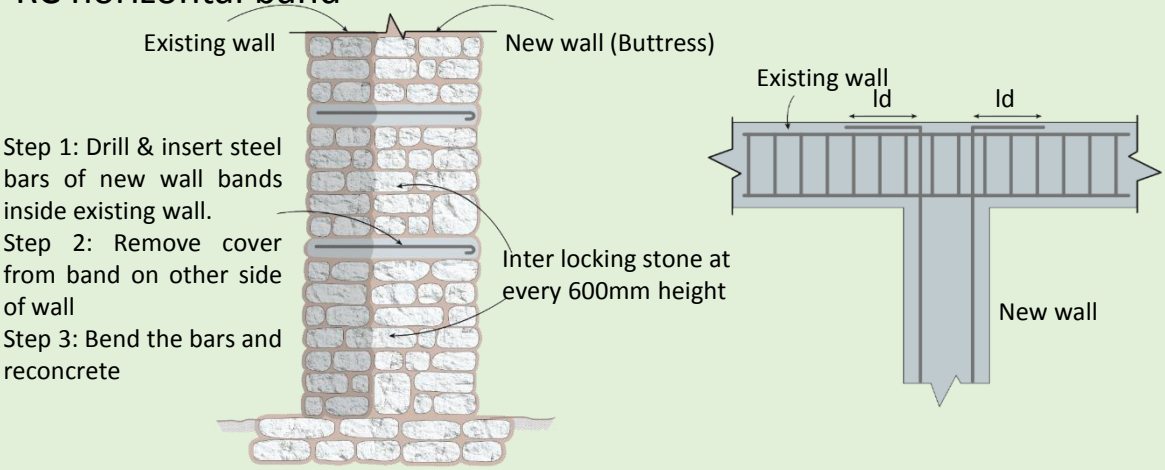


* For other typology of construction, see NBC.

* Provide buttress either outside of wall as shown in figure or inside the room.

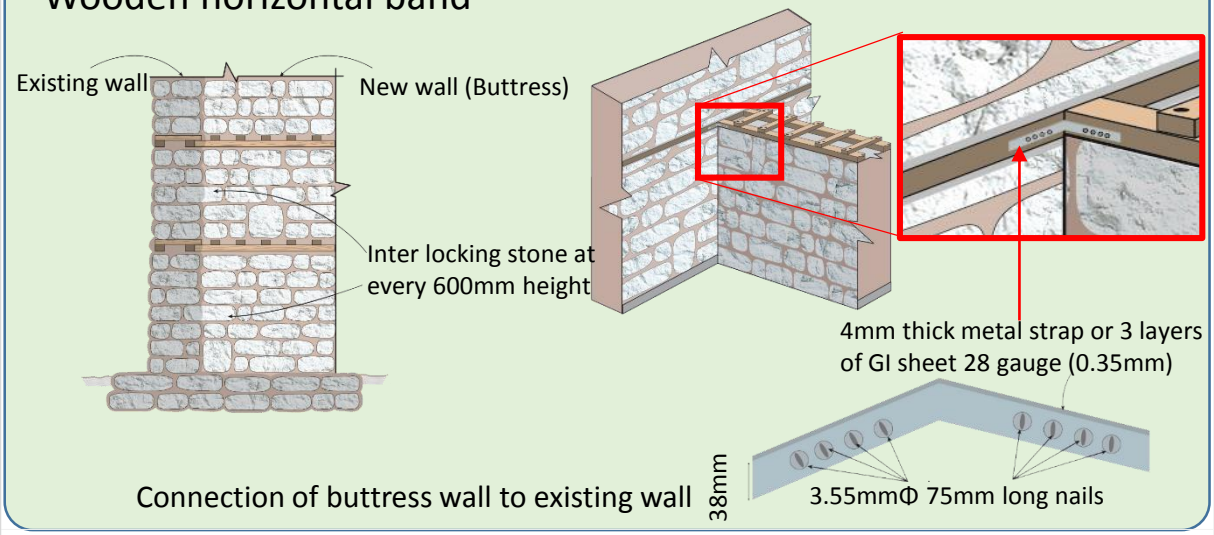
*Addition of buttress wall when length of wall is greater than 12t (mud mortar)

RC horizontal band



Connection of buttress wall to existing wall

Wooden horizontal band

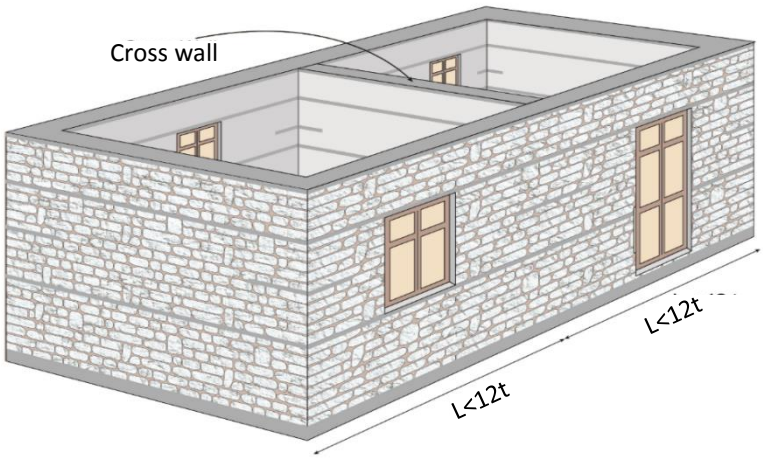


Connection of buttress wall to existing wall

2.2 Configuration and load path improvement…

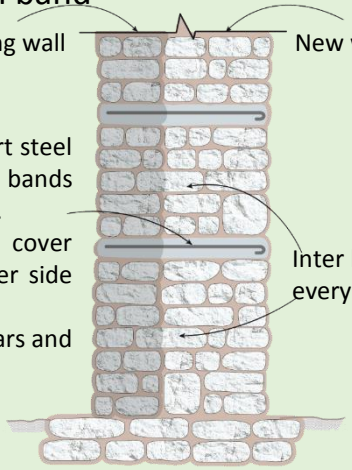
Example 2 : Construction details of New Cross wall in mud mortar with flexible

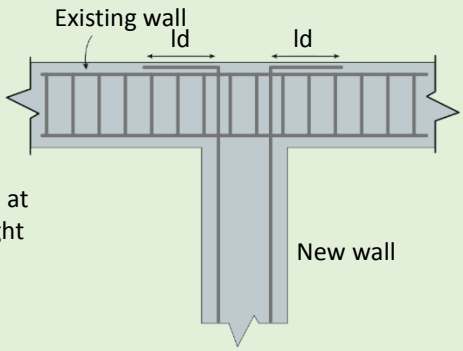
* For other case, see NBC



Addition of cross wall when length of wall is greater than 12t.

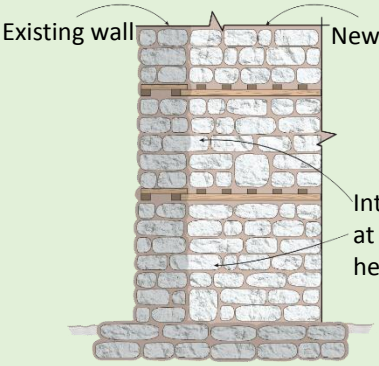
RC horizontal band

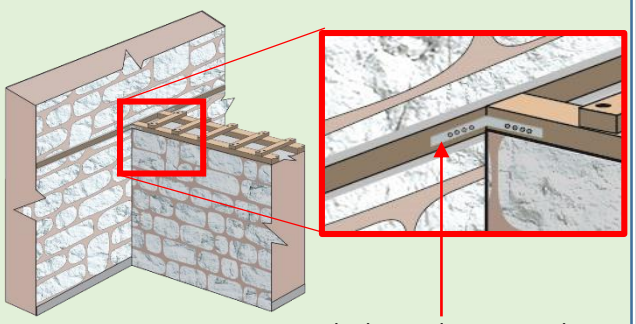


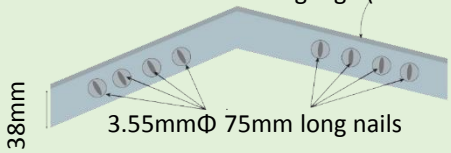


Connection of cross wall to existing wall

Wooden horizontal band







Connection of cross wall to existing wall

3.0 Connection improvement between wall - to – wall

Option 1: anchored splint (using RC elements with rebar or G.I. wire mesh) at corner or T-Junction in both side of wall with proper connection between new and existing walling material should be done.

Rebar anchored R C splint

G I wire mesh anchored R C splint

*See details in ready to use seismic retrofit designs, summary

3.1 Connection improvement between wall-to-wall…

Option 2: anchored splint (using wooden elements) at corner or T-Junction in both side of wall with proper connection between new and existing walling material should be done.

Installation of wooden vertical member from inside of the wall

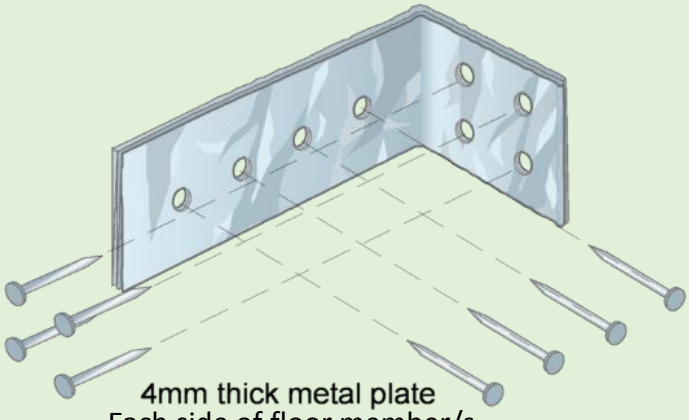
*See details in ready to use seismic retrofit designs, summary

4.0 Connection improvement between wall-to- floor

Option 1: Metal Strap :

When it is not possible to transport concrete and steel to the site:

Details of metal strap



Note : Minimum four numbers of 50 mm long nails (Fe250) with Floor member and Minimum four numbers of M16 grade expansion bolts with walling material

Option 2: Timber block :

When it is not possible to transport concrete and steel to the site:

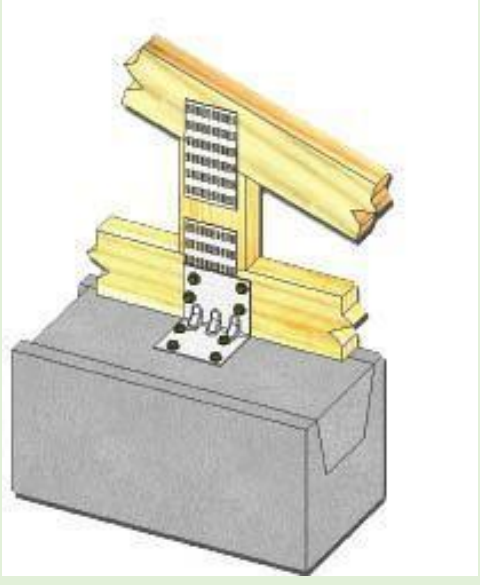
Timber block/Joist : Depth x width = 50 mmx30 mm (Hard wood) with required length and 75 mmx45 mm (Other wood) with required length

Details of timber block

5.0 Connection improvement between wall - to - roof

Option 1: Metal Strap at the top of wall:

Note : This is not required separately if retrofitting is done simultaneously. Splint is connected to the floor joist and roof rafters.

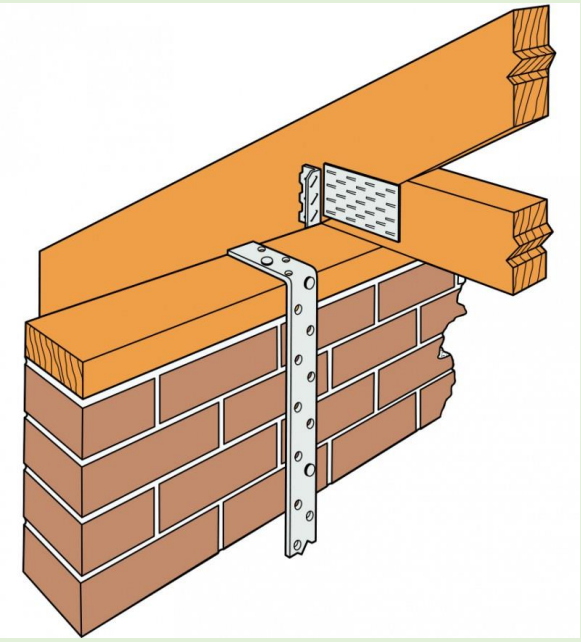


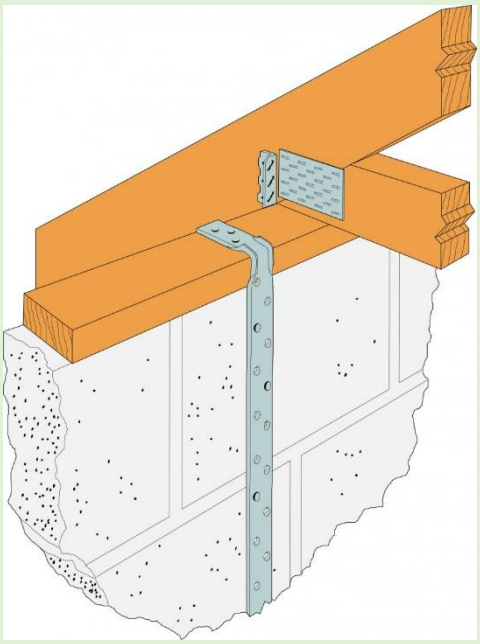
3 mm thick Height and depth : 45mmx45mm, M12 of 4 number, M16 of one number in each face @ 3.00 mat centres

Details of Anchor plate

Option 2: Metal Strap at side of wall:

Note : This is not required separately if retrofitting is done simultaneously. Splint is connected to the floor joist and roof rafters.

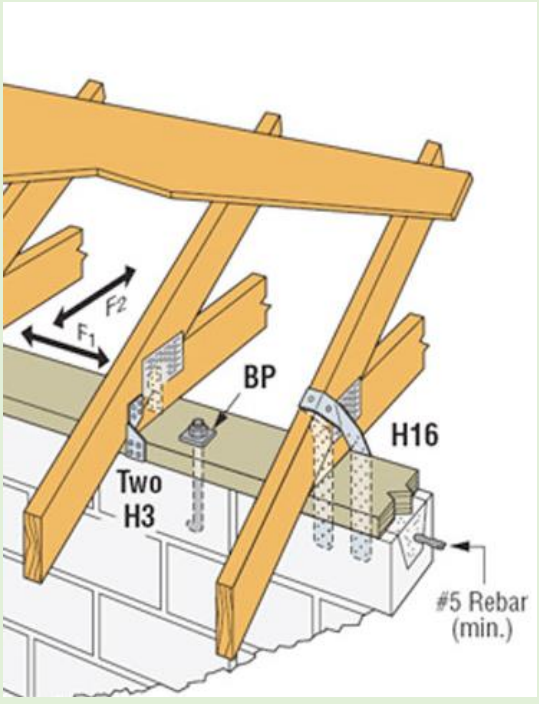




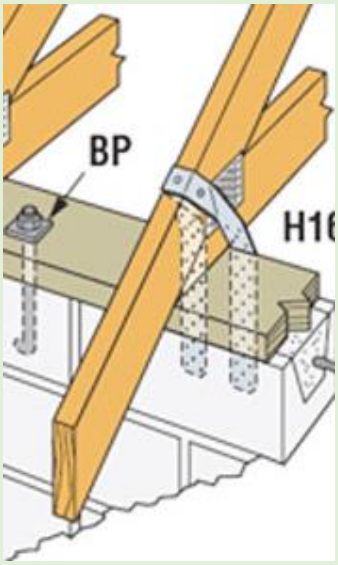
3 mm thick width and depth : 115mmx300mm, M8 of 4 number, (width side) and M8 of 8 numbers depth side face @ 4.5 m at centres

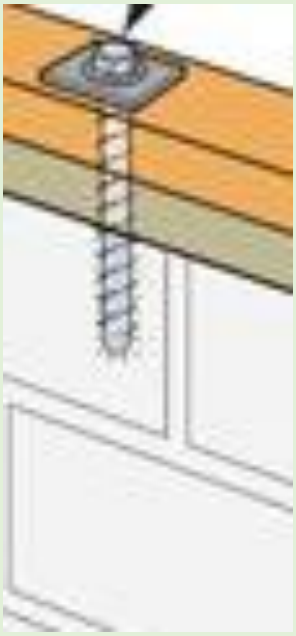
Details of Anchor plate

Option 3: Metal Strap with Screws :



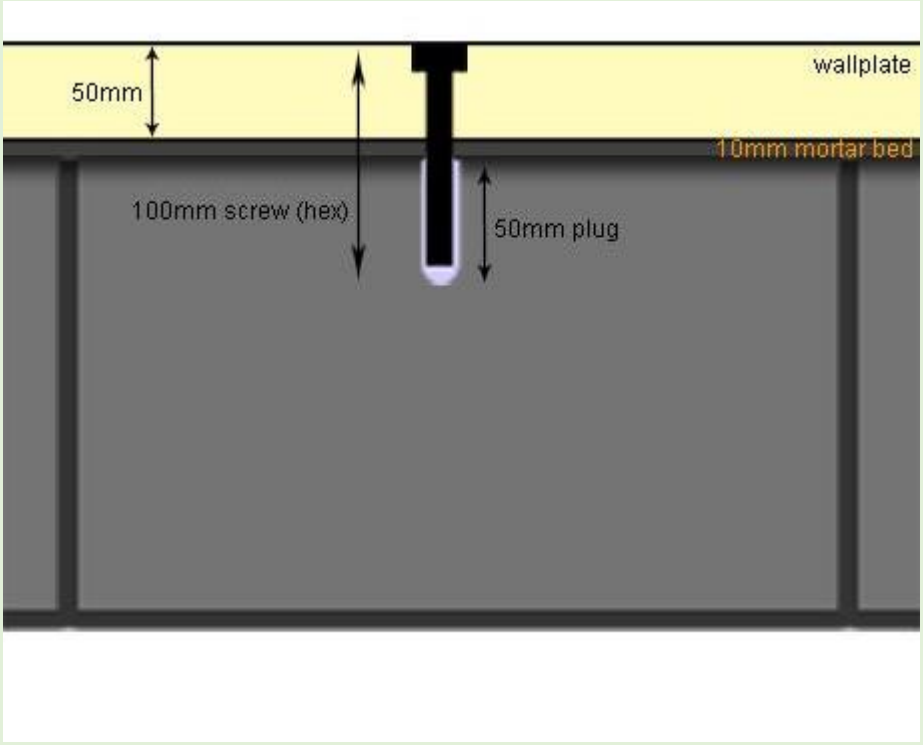
Note : 3 mmm thick metal strap, Minimum four numbers of 50 mm long nails (Fe250) with Floor member and Minimum four numbers of M16 grade expansion bolts with walling material





Details of Anchor plate

Option 4: Use of metal screw :

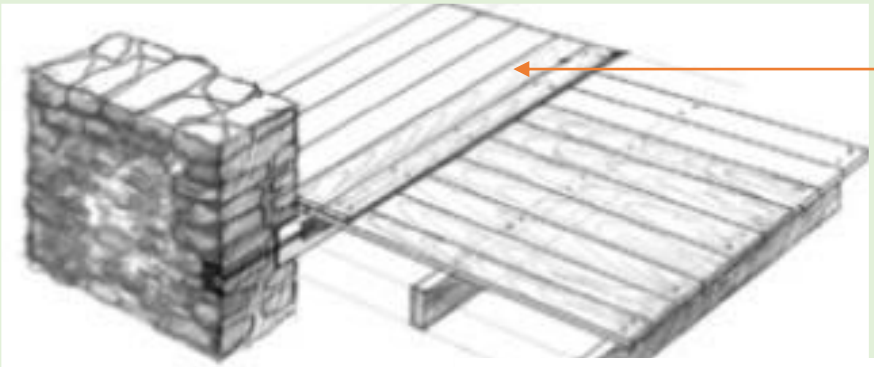


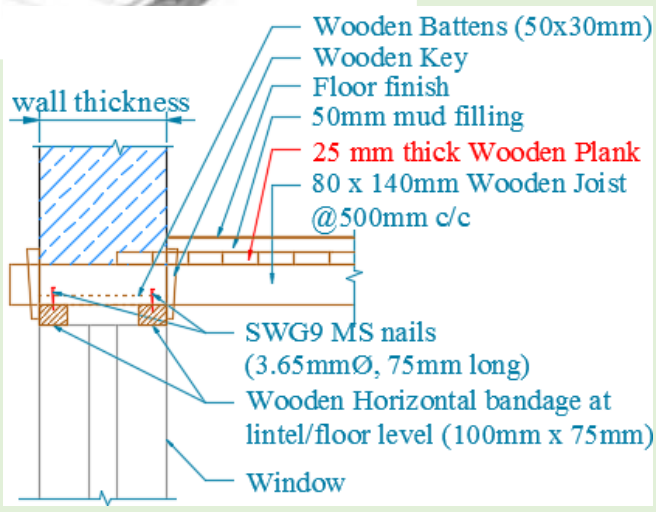
Note : Minimum four numbers of 50 mm long nails (Fe250) with Floor member and Minimum four numbers of M16 grade expansion bolts with walling material

6.0 Stiffening of floors in their plane

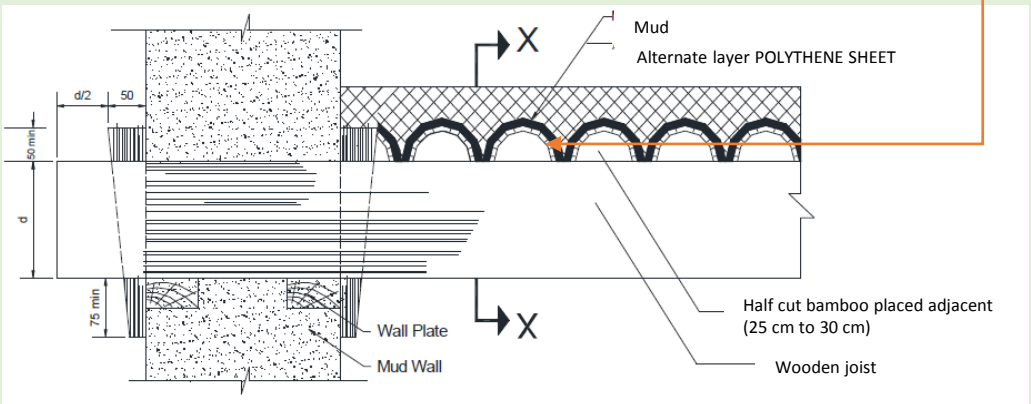
Option 1: Wooden plank overlay or half cut bamboo overlay:

25mm thick Wooden Plank overlay



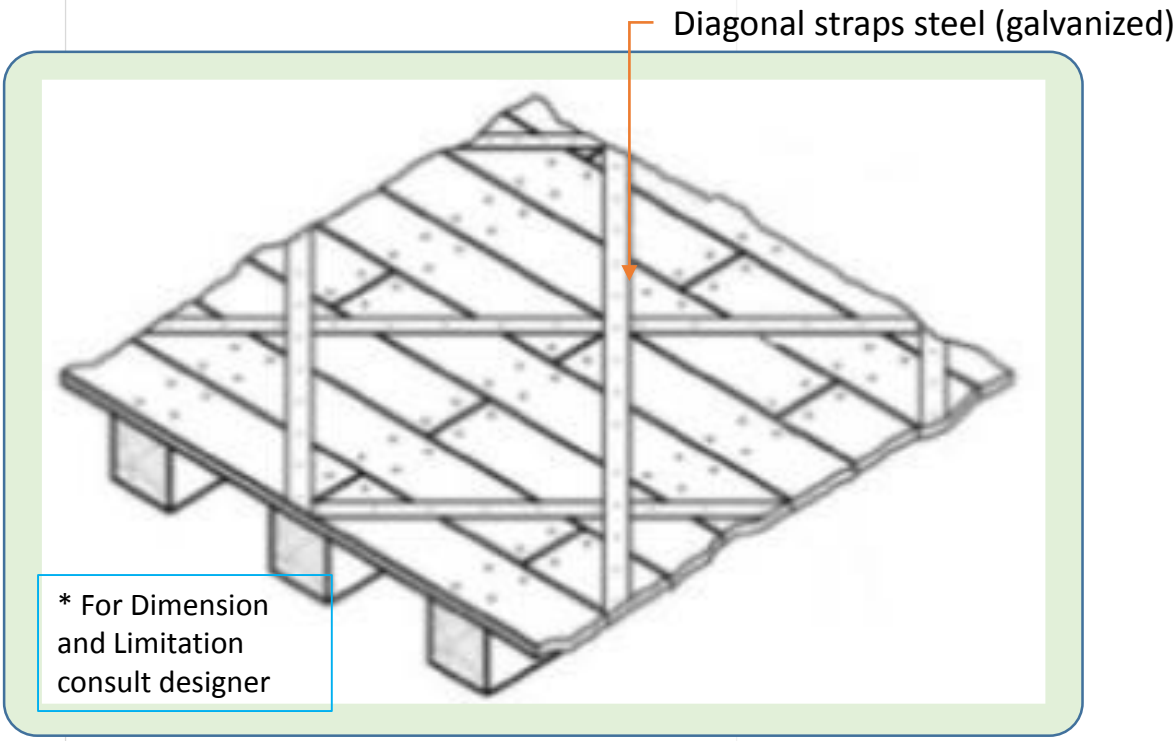


Half cut bamboo overlay

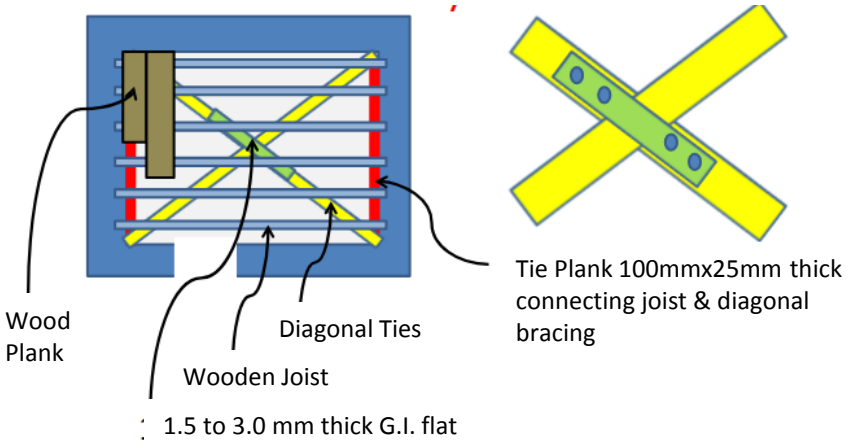


Option 2: Diagonal straps steel (galvanized):

When it is not possible to transport concrete and steel to the site:



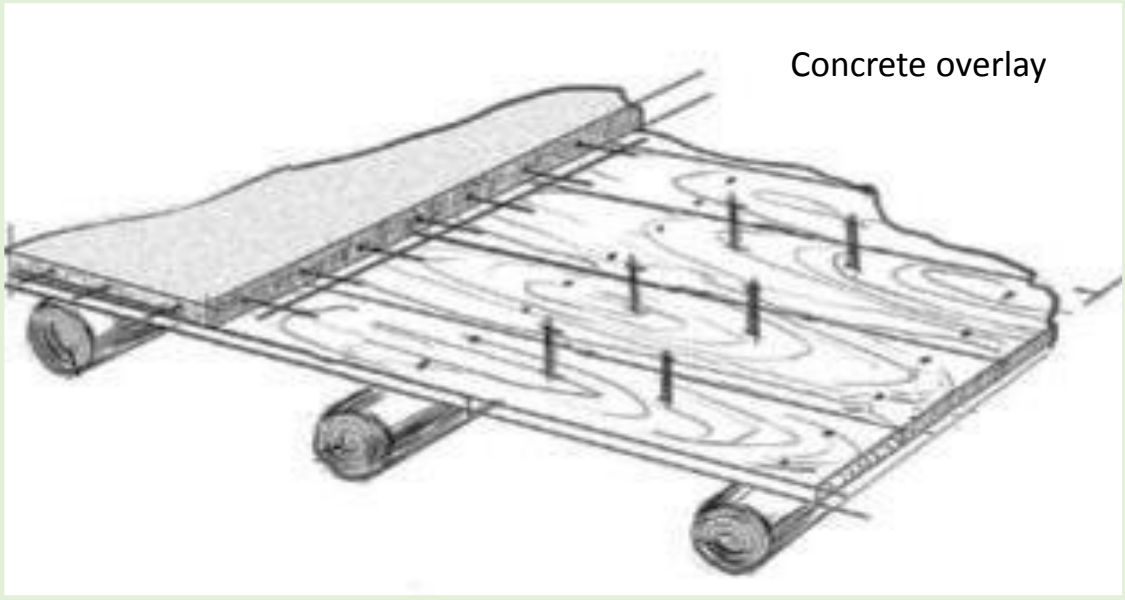
Stiffening flat wooden floor/roof resting on stone or brick masonry

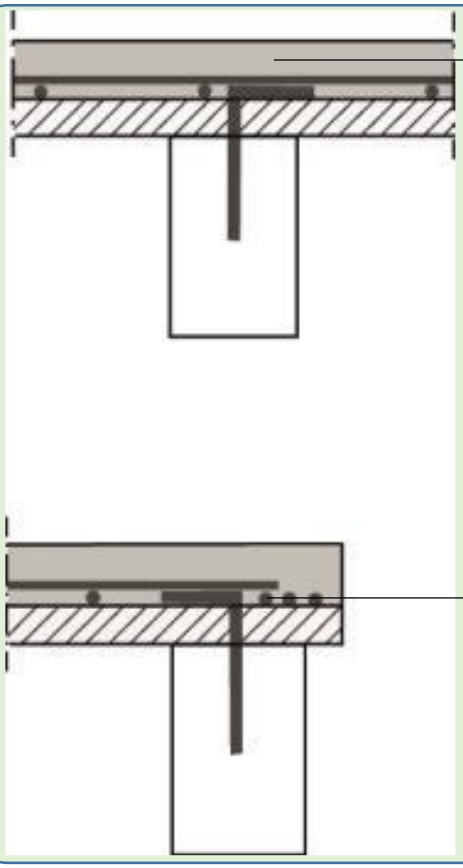


Details of diagonal straps steel (galvanized) plate

6.2 Stiffening of floors in their plane …

Option 3: Concrete overlay:



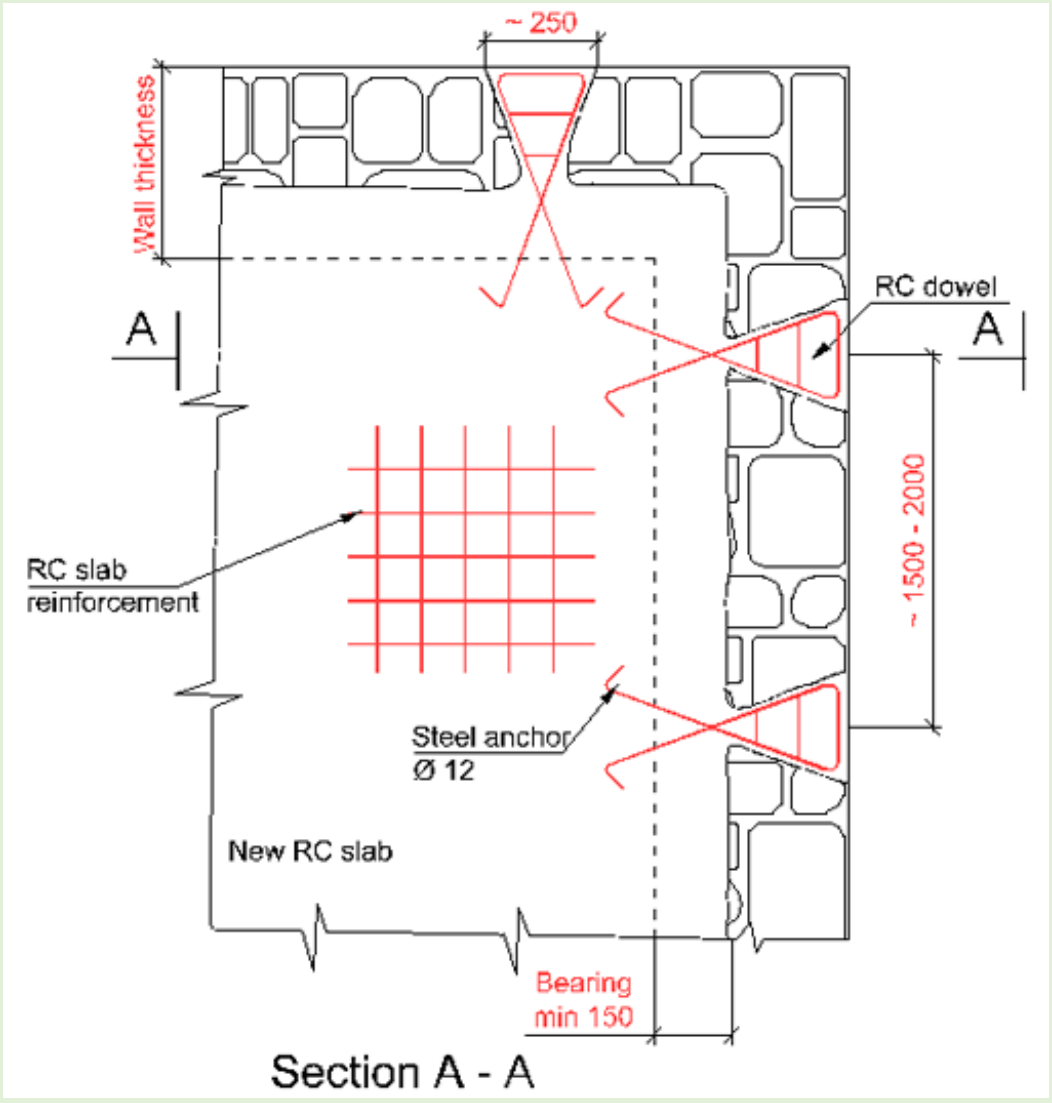


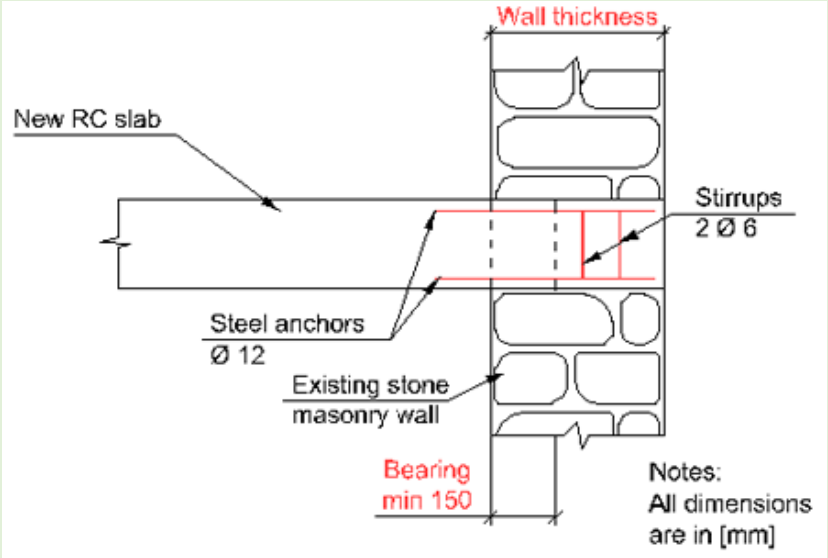
6 mm dia mesh
200 mm c.c.
50 mm concrete slab

3x 14 mm dia additional
chord reinforcement

6.3 Stiffening of floors in their plane…

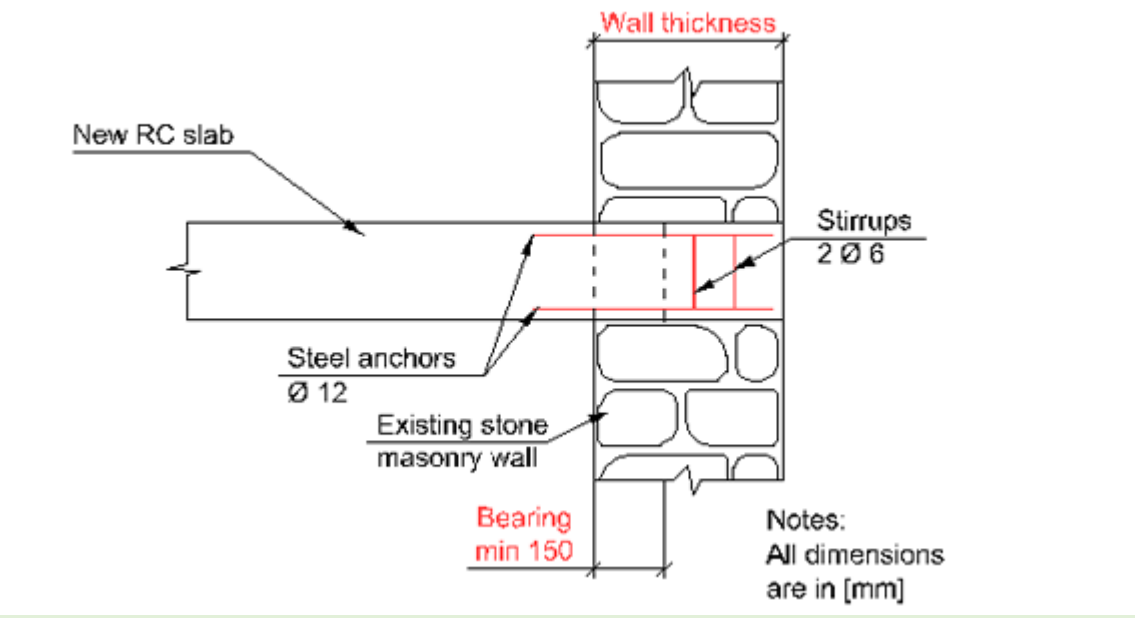
Option 4: New RCC slab :

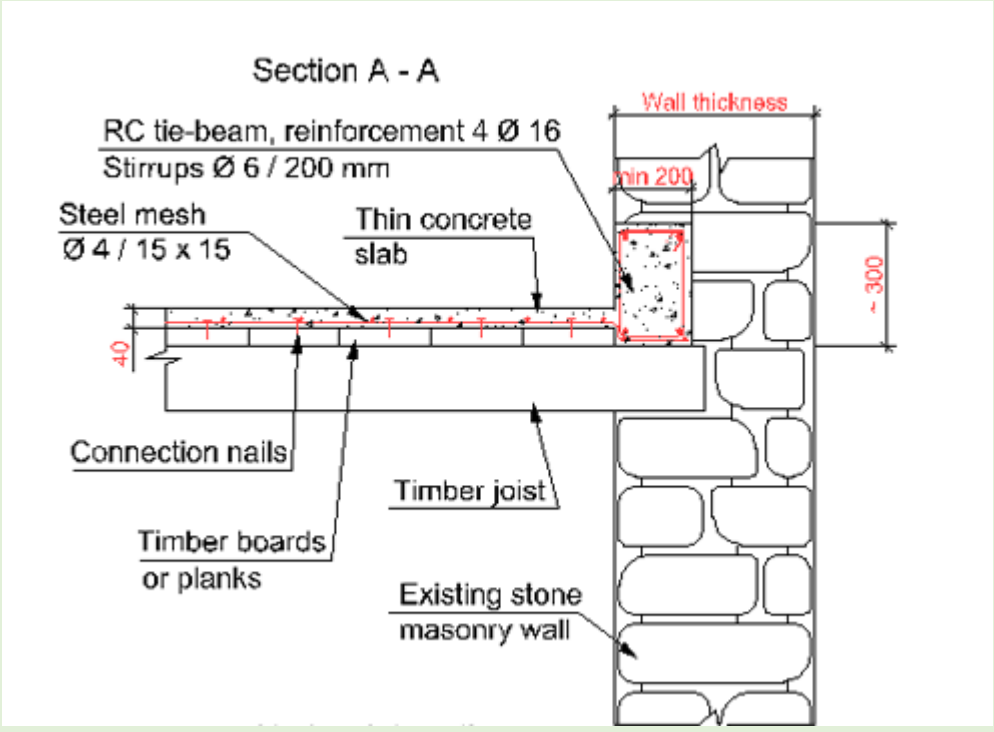




6.3 Stiffening of floors in their plane…

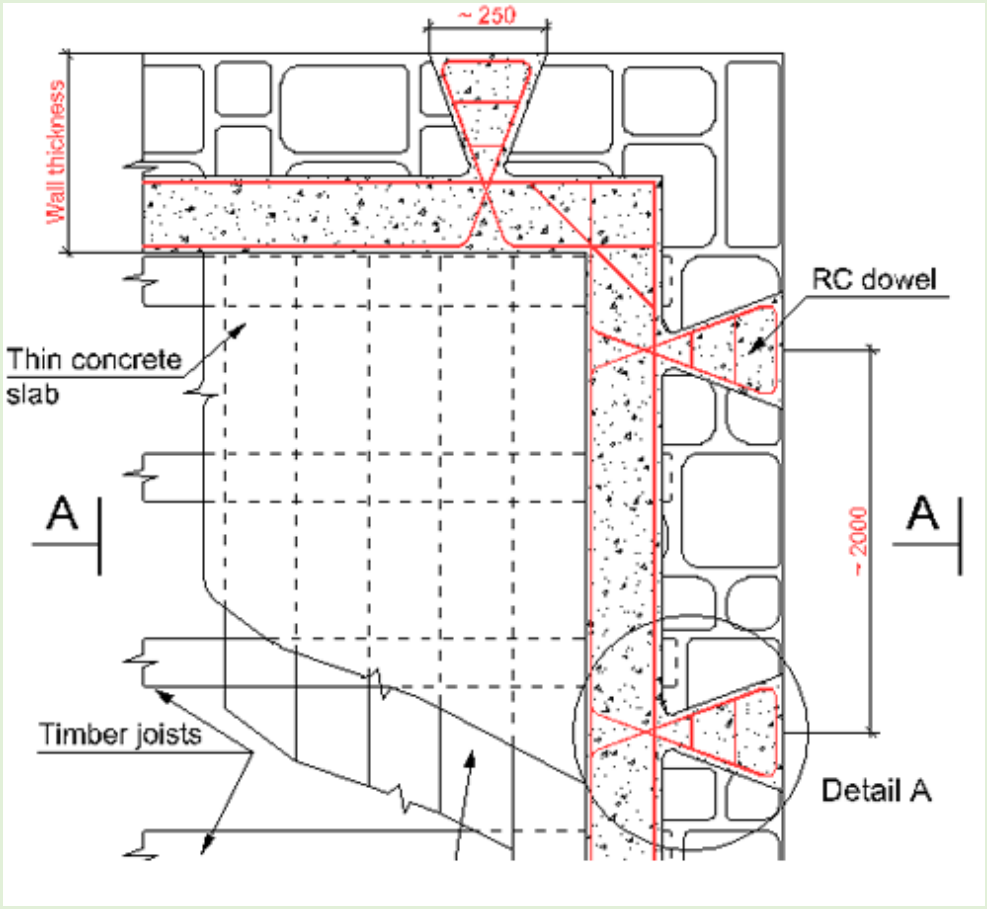
Option 4: New RCC slab :



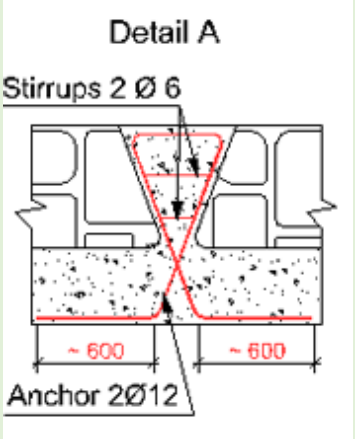


Details of new RC

Option 4: New RCC slab :



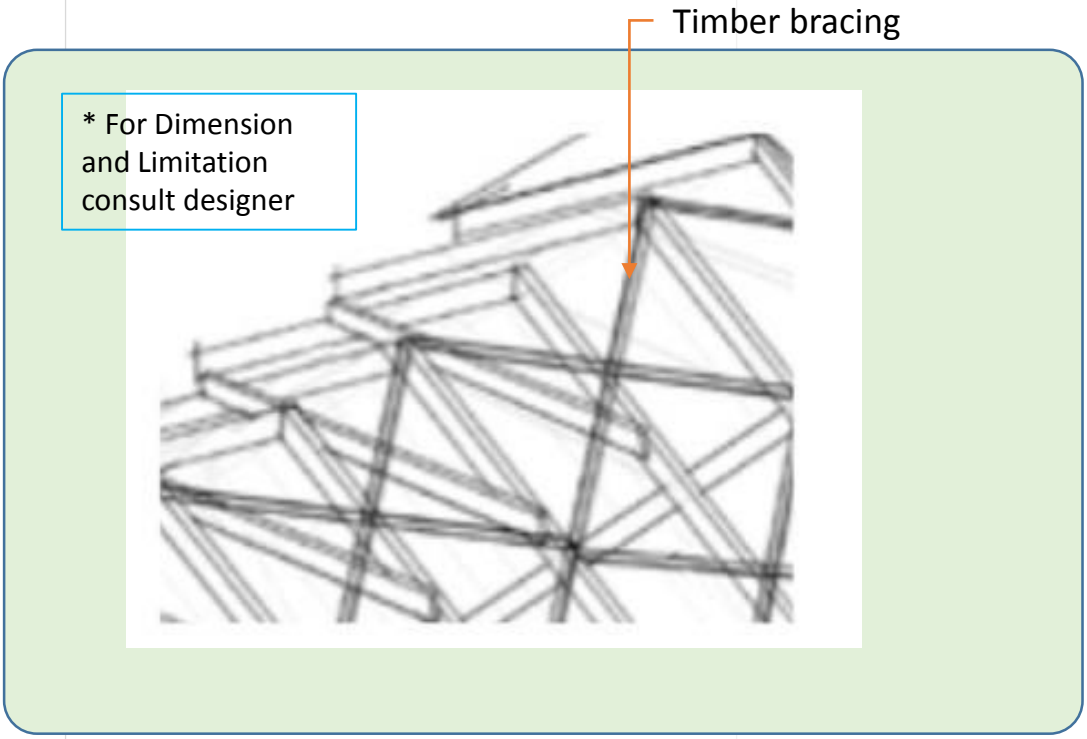
Details of new RC



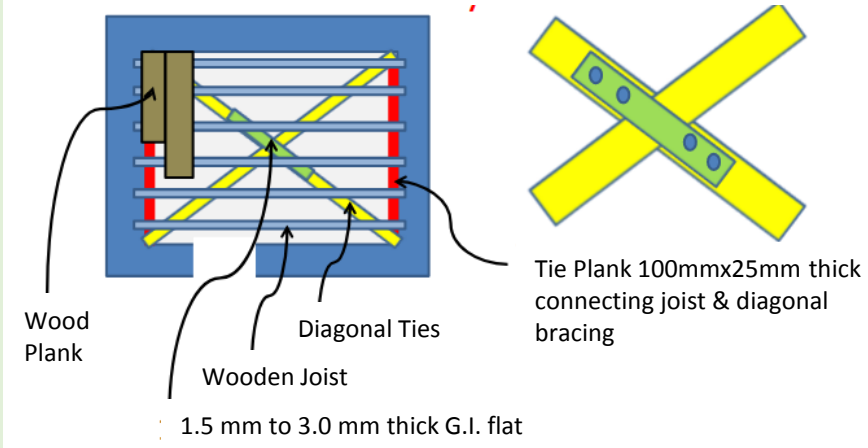
7.0 Stiffening of roofs in their plane

Option 1: Timber bracing :

When it is not possible to transport concrete and steel to the site:



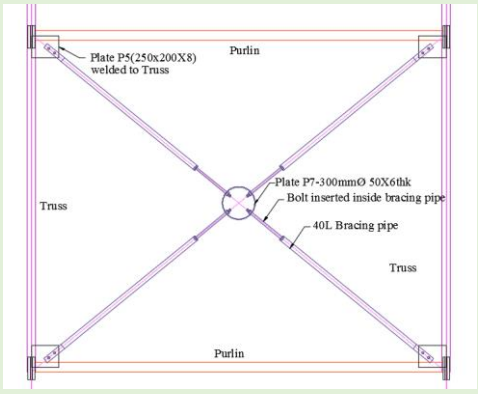
Stiffening flat wooden floor/roof resting on stone or brick masonry

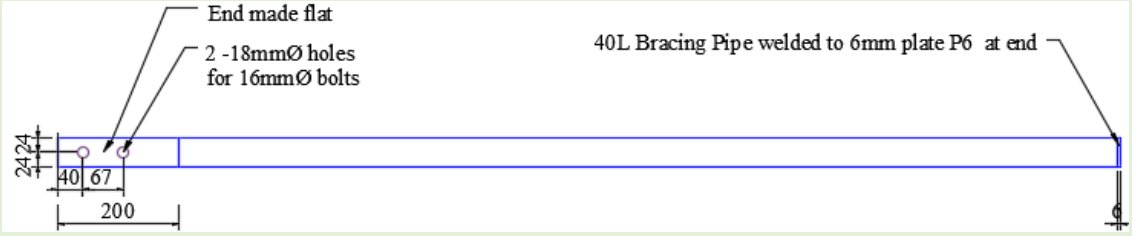


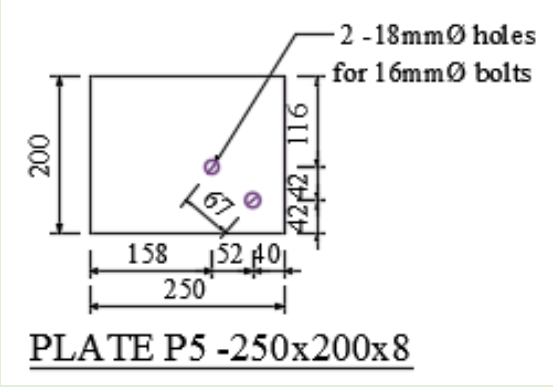
Details of diagonal straps steel (galvanized) plate

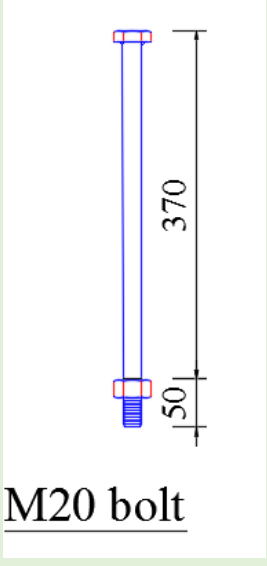
Option 2 : Steel bracing :

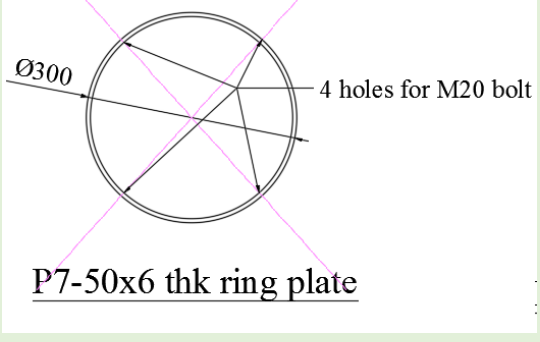
When it is not possible to transport concrete and steel to the site:







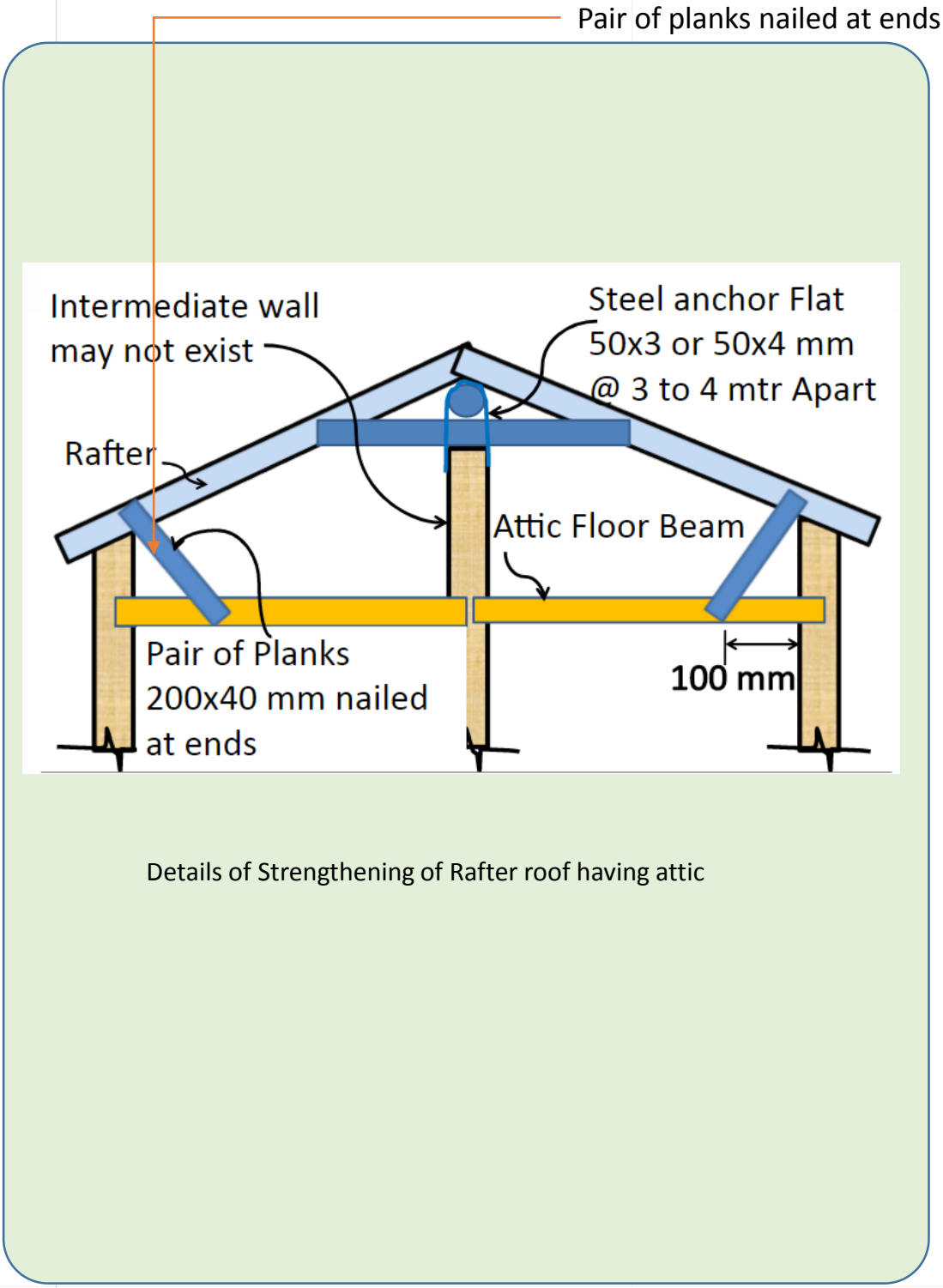




Details of steel bracing

7.0 Stiffening of roofs in their plane …

Option 3 : Strengthening of Rafter roof having attic :

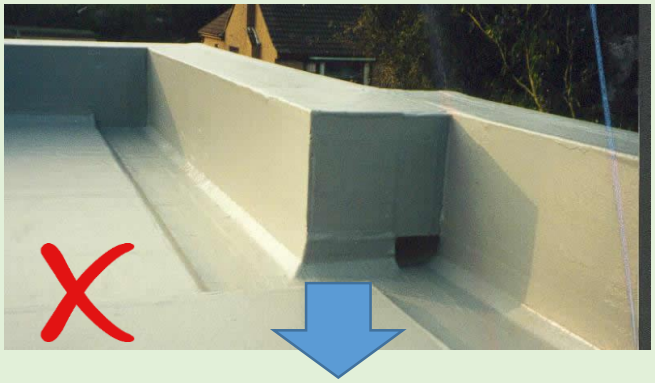


Details of Strengthening of Rafter roof having attic

8.0 Tying of parapet walls

- Replace heavy masonry with lighter material such as steel, wooden or bamboo elements with proper connection Or
- Provide bracing or parapet band with proper connection with existing walling/floor/roof material.

URM masonry parapet wall



Steel parapet with proper connection with slab or beam

Parapet wall with RC band & vertical RC post as per NBC practices

Wooden parapet with proper connection with floor joists

Masonry parapet braced with steel section with proper connection with slab or beam

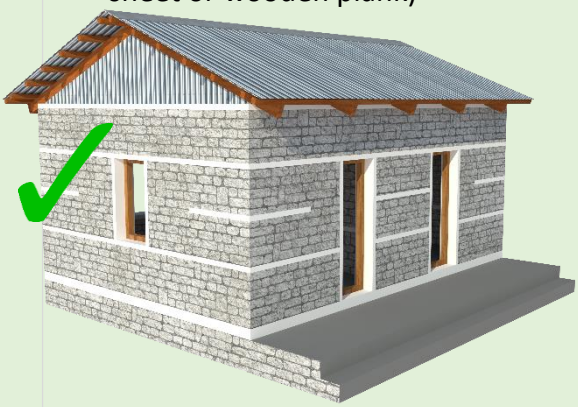
9.0 Tying of gable walls…

URM gable wall

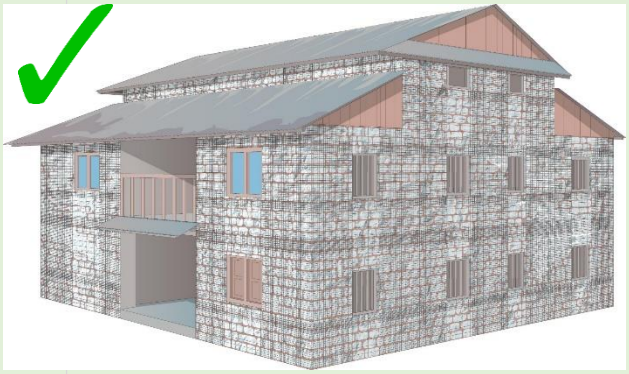
Intervention

Replace the gable walls by light-weight materials such as galvanized iron sheets or wood panels. Where it cannot be done, confine the wall materials properly by complete jacketing or Bandages at roof and eaves level and Splint with span not exceeding 2.0m.

Replace with Light weight material (CGI sheet or wooden plank)



Provide external splint & bandage



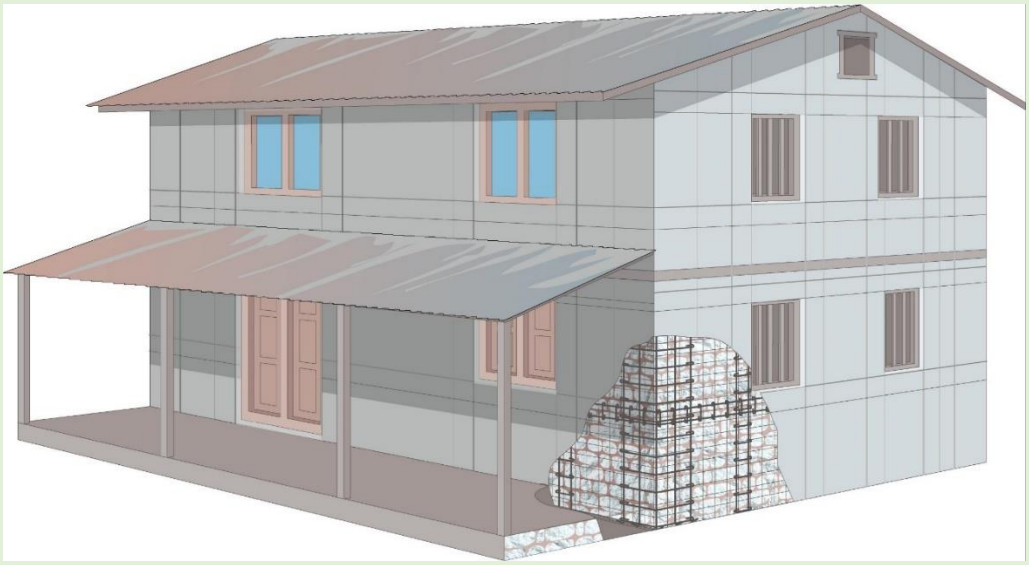
10.0 Capacity improvement of structural wall

Note : This page give informative knowledge regarding the given retrofitting techniques. For more details and clarity, refer annex 1 (separate volume in A3 paper sheets).

Option 1: Retrofitting using RC splint-bandage (For preventing global failure) and GI wires in remaining part (for Local failure)

Retrofitting using rebar with concrete Splint-bandage and GI wire mesh Jacketing (Brick Masonry)

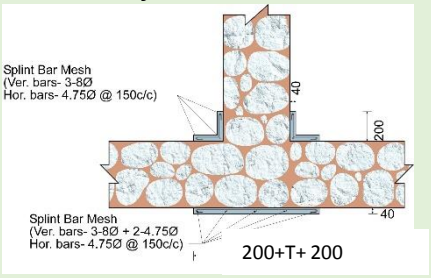
Option 1: Retrofitting using RC splint-bandage (For preventing global failure) and GI wires in remaining part (for Local failure)



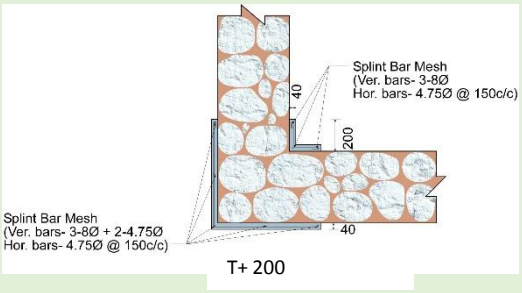
Retrofitting using rebar with concrete Splint-bandage and GI wire mesh Jacketing (Stone Masonry)

Option 1: Typical details at T- & Corner junction, and anchorage details

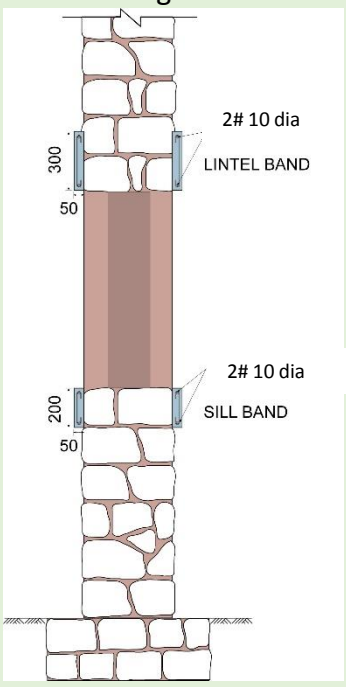
T-junction detail



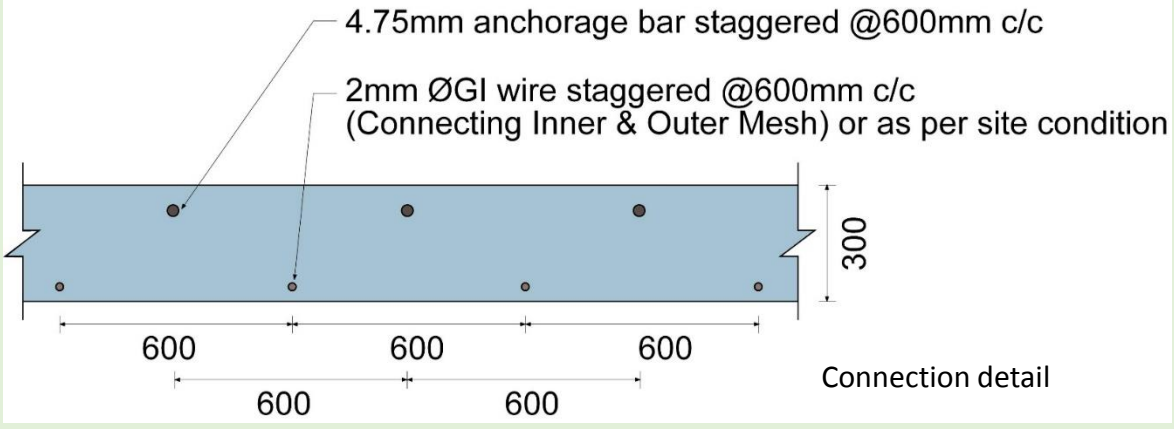
Corner-Junction detail



Bandage detail



Connection detail

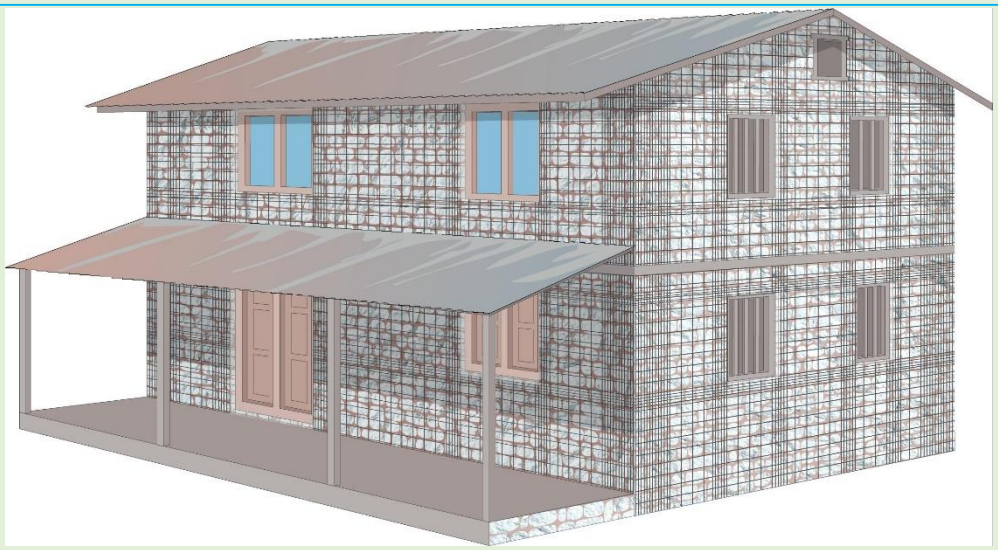


Connection detail

Note : This page give informative knowledge regarding the given retrofitting techniques. For more details and clarity, refer annex 1 (separate volume in A3 paper sheets).

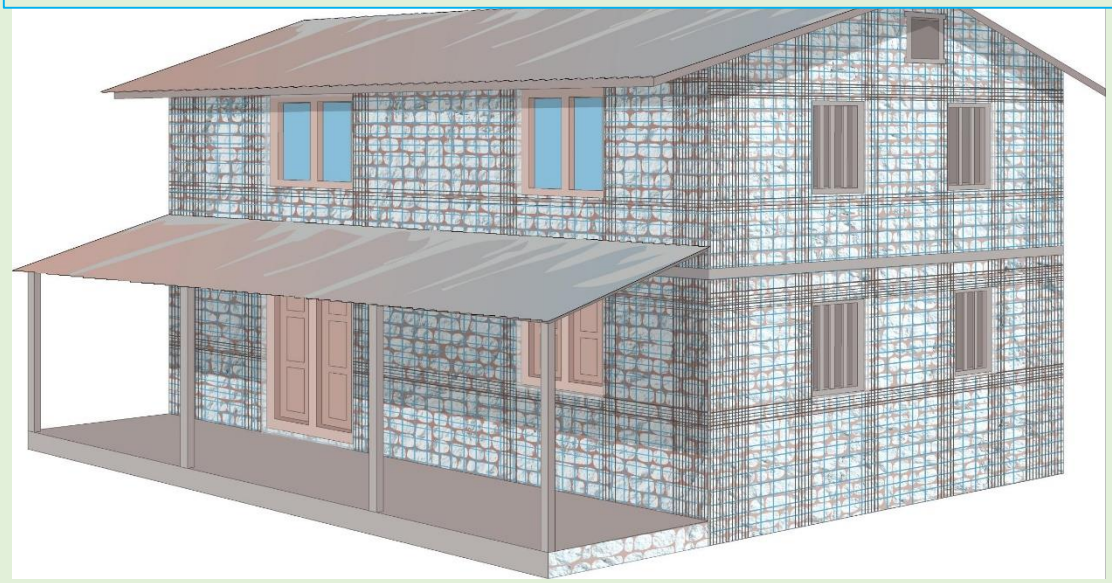
Note : This page give informative knowledge regarding the given retrofitting techniques. For more details and clarity, refer annex 1 (separate volume in A3 paper sheets).

Option 2: Retrofitting using Welded GI wire mesh Splint –bandage (For preventing global failure) and GI wire jacketing (for Local failure)



Retrofitting using Welded wire mesh Splint-bandage and GI wire mesh Jacketing (Stone Masonry

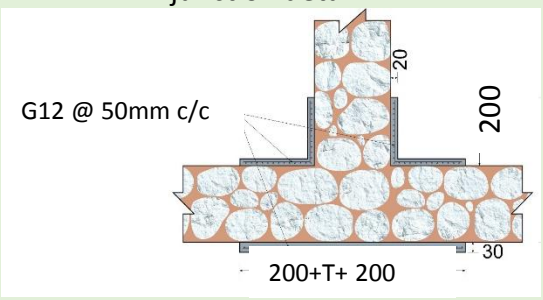
Option 3: Retrofitting using Welded GI wire mesh Splint –bandage (For preventing global failure) and PP band in remaining part (for Local failure)



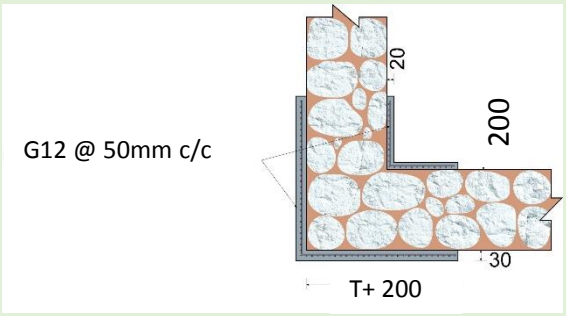
Retrofitting using Welded wire mesh Splint- bandage and P.P. wire mesh Jacketing (Stone Masonry)

Option 2 & 3 : Typical details at T- & Corner junction, and anchorage details

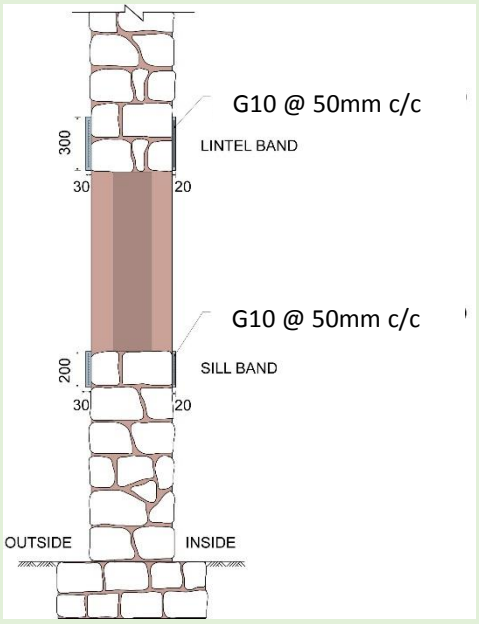
T-junction detail



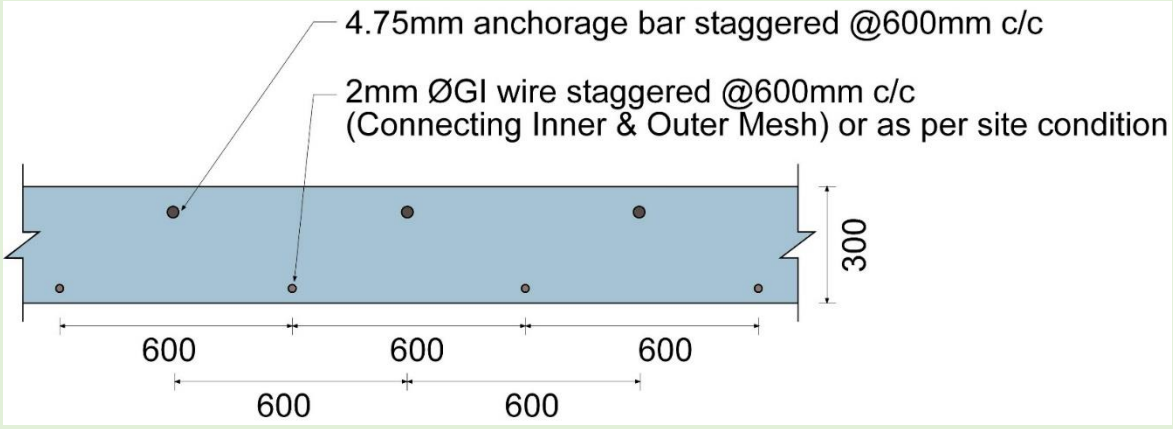
Corner-Junction detail



Bandage detail



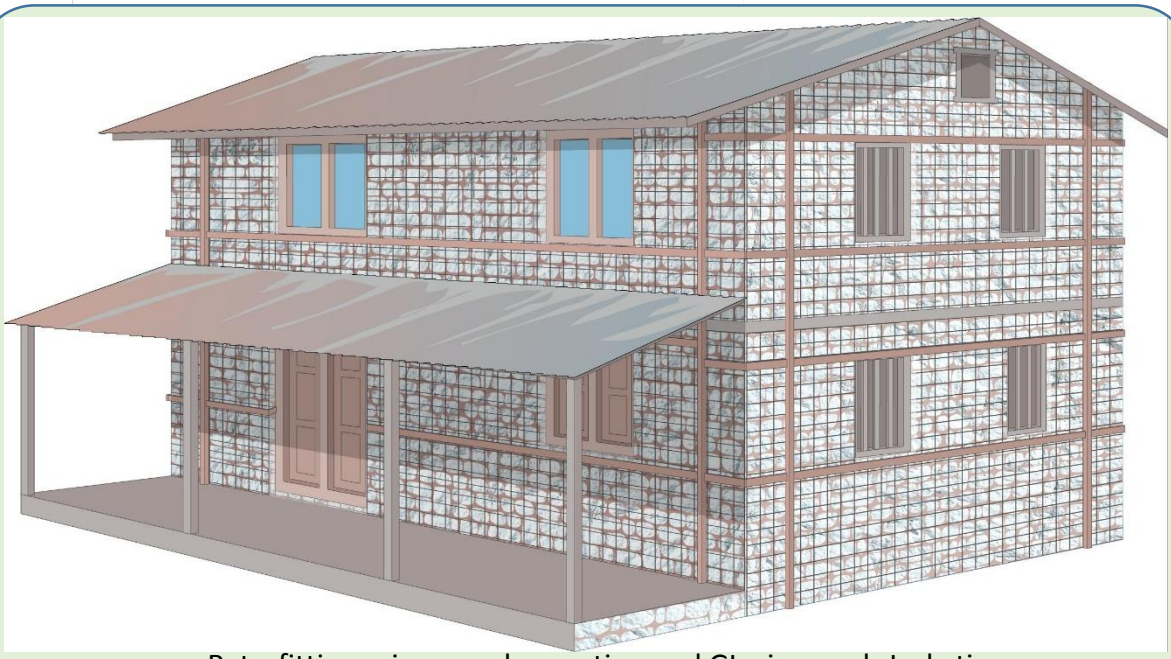
Connection detail



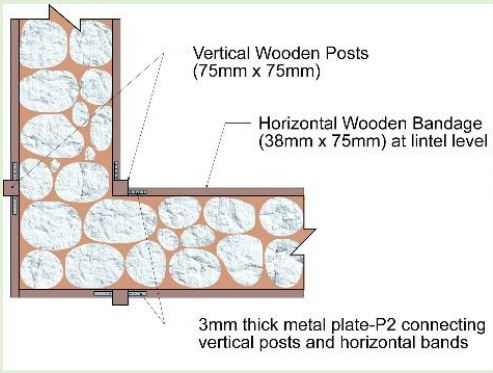
Connection detail

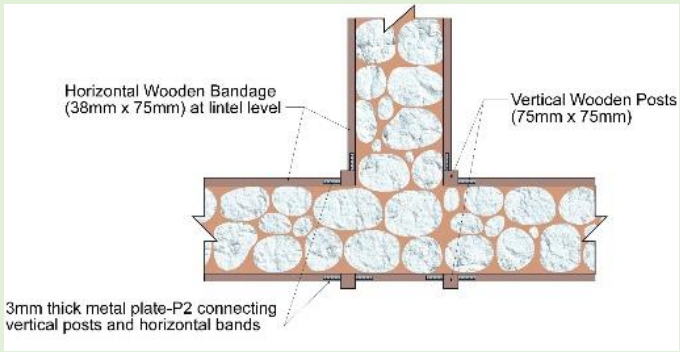
Note : This page give informative knowledge regarding the given retrofitting techniques. For more details and clarity, refer annex 1 (separate volume in A3 paper sheets).

Option 4: Retrofitting using wooden splint-bandage (For preventing global failure) and GI wires in remaining part (for Local failure)



Retrofitting using wooden section and GI wire mesh Jacketing





Note : This page give informative knowledge regarding the given retrofitting techniques. For more details and clarity, refer annex 1 (separate volume in A3 paper sheets).

PART-C : Ready to use seismic retrofit designs

This section presents summary of retrofit designs which are applicable in following cases :

- Retrofitting Stone masonry building
  1) Retrofitting stone masonry building in mud (RSMM)
  2) Retrofitting dry stone masonry building (RDSM)

- Retrofitting brick masonry building
  1) Retrofitting brick masonry building in mud with flexible floor (RBMM)
  2) Retrofitting brick masonry building in cement with flexible floor (RBMC1)
  3) Retrofitting brick masonry building in cement with rigid floor (RBMC2)

[Typical description of building]

- Number of storey : 2 plus attic (maximum), except RBMC2 which is three storey
- Storey height : 3.00 m (maximum)
- Total height : 7.0m (2 plus attic) and 9.0 m (three storey)
- Unsupported wall length: 5.40 m (maximum)
- Plinth area : 100.00 sq.m.
- Configuration and load path : is similar as mention in part B : Seismic deficiency and intervention)
- Redundant : Yes
- Material condition : Good or replaced with new material in case of damaged.

[Note:] : the design given in this section are applicable to those building which meets the description mentioned above under typical description of buildings. In other case, structural design shall be done.

Capacity improvement of structural wall : Design Summary

Option 1 : Summary of design : For RC splint & bandage

Table 3: Summary of retrofit design (applicable to RSMM, RDSM, RBMM RBMC1 : 2 plus attic storey & RBMC-2* : three storey)

S.N.	Length or Wall	Rebars Reinforcement in seismic belts with overlapping of Ld mm	
	In meter	Concrete Size (mm)	Rebar (No & diameter)
1.	≤ 5.40	300 x 40	2#10 ϕ

Note : Material grade : M20 and Fe 500 or 415 , ties 4.75 mm diameter bars @ 150 m spacing.

Split : Rebar in RC seismic splint with overlapping of Ld mm,

SN	No. of storey	Storey	Concrete size (Width x thickness	At T-Junction		At Corner Junction		At near opening	
Concrete Grade M 20, Rebar Grade Fe 500				No	Bar ϕ (mm)	No	Bar ϕ (mm)	No	Bar ϕ (mm)
1	One		200x40	3	8	3	8	2	8
2.	One plus attic	attic	200x40	3	8	3	8	2	8
		Ground	200x40	3	8	3	8	2	8
3.	Two	First	200x40	3	8(10)	3	8	2	8
		Ground	200x40	3	8 (10)	3	8	2	8
4.	Two plus attic/second	Attic/Second	200x40	3	10	3	8	2	8
		First	200x40	3	10	3	8	2	8
		Ground	200x40	3	10	3	8	2	8

Note :1) Material grade : M20 and Fe 500 or 415 , ties 4.75 mm diameter bars @ 150 mm spacing.

: 2) The splints which is provided to out side of the room shall be of 200+2*wall thickness and 200+wall thickness at T –junction and at corner respectively with 2 Numbers of 4.75 diameter vertical bars additionally.

Provide G.I. wire mesh at 100 mm at cetres in horizontally and vertically to prevent local failures.

: values in parenthesis is RBMC -2

Capacity improvement of structural wall : Design Summary

Option 2 & 3 : Summary of design : For Welded G.I. Mesh splint & bandage

Table 1: Summary of retrofit design (applicable to RSMM, RDSM and RBMM)

S.N.	Length or Wall	G.I. Mesh Reinforcement in seismic belts with overlapping of 300mm		
	In meter	Gauge	No.	Wide
1.	≤ 5.40	10	12 (5)	300 (200)

Gauge, G10 = 3.25mm.

- Value in parenthesis is for sill band, remaining in lintel band
- concrete thickness 20mm & 30mm for inner and outer section.

Split : G.I. Mesh Reinforcement in seismic splint with overlapping of 300mm,(applicable to RSMM, RDSM and RBMM)

SN	No. of storey	Storey	G	At T-Junction		At Corner Junction		At near opening	
				No	W	No	W	No	Wide
1	One		12	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)
2.	One plus attic	attic	12	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)
		Ground	12	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)
3.	Two	First	10	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)
		Ground	10	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)
4.	Two plus attic	attic	10	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)
		First	10	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)
		Ground	10	18 (5)	2X200 +T (200)	14 (5)	200 +T (200)	5 (5)	200 (200)

Values in parenthesis () is for splint in side of the room and remaining value is for splint outside the room.

Gauge, G10 = 3.25mm, G12 = 2.64mm

Note : provide PP band or G.I. wires (G12) at 100 mm at centers vertically and horizontally to prevent local failures in remaining portion of the walls.

- concrete thickness 20mm & 30mm for inner and outer section.

Option 4 : Summary of design : For wooden splint & bandage

Table 2: Summary of retrofit design (applicable to RSMM and RDSM)

S.N.	Length or Wall	Wooden member in seismic belts with proper overlapping.		
	In meter	size	No.	Wide
1.	< 5.40	38mmX75mm	2 (each face)	
Note : Connection using MS plate.				

Split : wooden member **in seismic splint with proper overlapping .**						
SN	No. of storey	Storey	Size	At T-Junction	**At Corner Junction**	**At near opening**
				No	No	No
1	One		75x75	4	3	4
2.	One plus attic	attic	75x75	4	3	4
		Ground	75x75	4	3	4
3.	Two	First	75x75	4	3	4
		Ground	75x75	4	3	4
4.	Two plus attic	attic	75x75	4	3	4
		First	75x75	4	3	4
		Ground	75x75	4	3	4
Note : Connection using MS plate. Provide G.I. wire mesh of 12 gauge @100 mm at cetres in horizontally and vertically to prevent local failures.						

PART-D: Construction Sequences

[This section deals with construction sequences regarding repairs measures and retrofitting measures.]

PART-D.1: Repair Process

Repair does not improve the structural strength of the building and very deceptive for meeting the strength requirements of the next earthquake. Repair measures presented are :

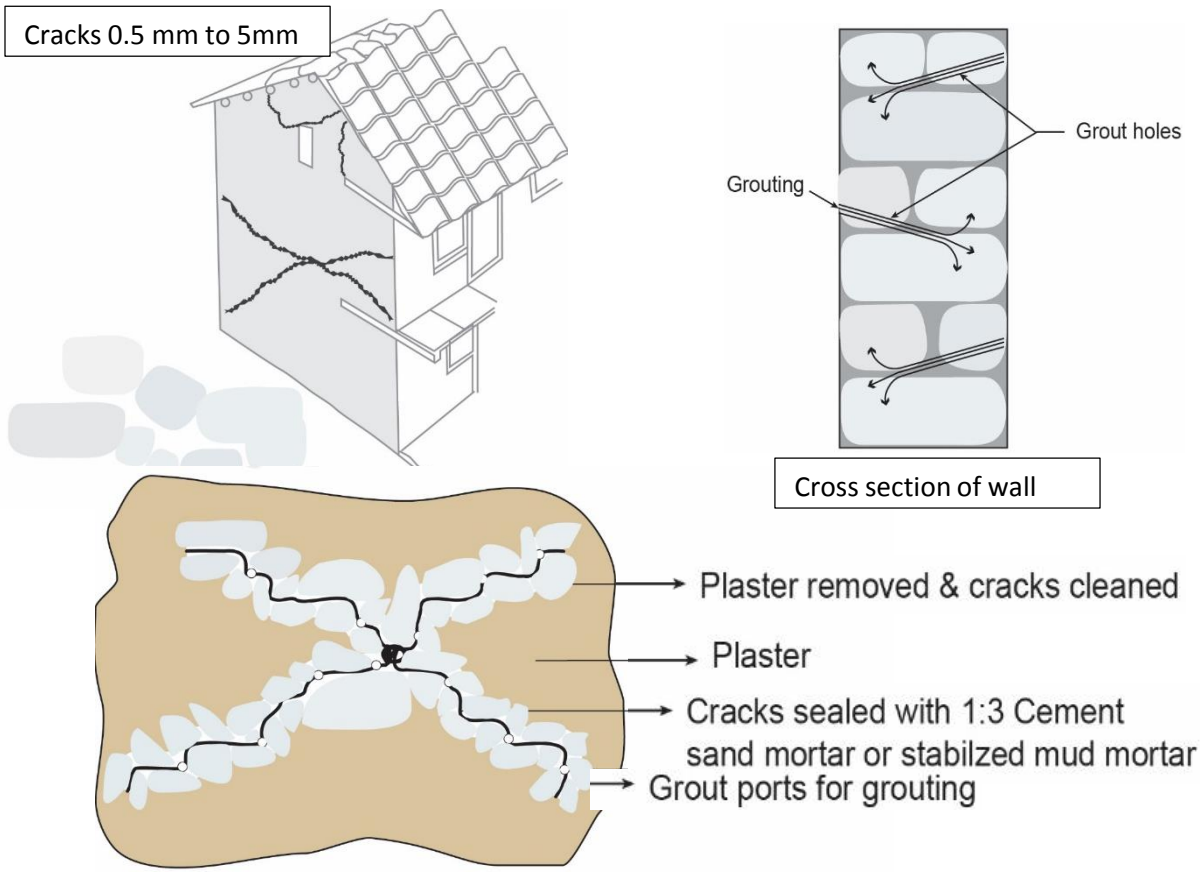
a) Action # 1: repair minor to cracks using grouting
b) Action # 2: repair major cracks by fixing wire mesh
c) Action # 3 : repair major cracks by using stitching elements
d) Action #4: repair of damaged wall by rebuilding

PART-D.2: General Retrofitting Process

[Retrofitting measures are meant for increasing the capacity of structural components of the building. This sub section gives typical construction process of retrofitting]

Material and Equipment

- Plastic or aluminum nipples of ½ inches in diameter and 1 to 1 ½ inches long in length.
- Grouting materials: the grout may be made using cement, sandy soil and fine sand mix in the proportions in 1:1:3 with enough water to make it into slurry. The soil and sand should be passing through ½ mm sieve.
- Cement and sand mortar of 1:3 for sealing the cracks.
- Container for injecting slurry at a height of 4 feet to 5 feet above the cracks with flexible hose pipe for flow of grout by gravity.



Steps : Grouting can be done as following:

Remove plaster in the vicinity of crack exposing the cracked bare masonry.

Make the shape of crack in V-shape by chiseling out.

Fix the grouting nipples in the V-groove on the faces of the wall at spacing of 6 to 8 inch c/c.

Clean the crack with compressed air through nipples to ensure that the fine and loose material inside the cracked masonry has been removed (Water injection should not be done in case of mud mortar masonry).

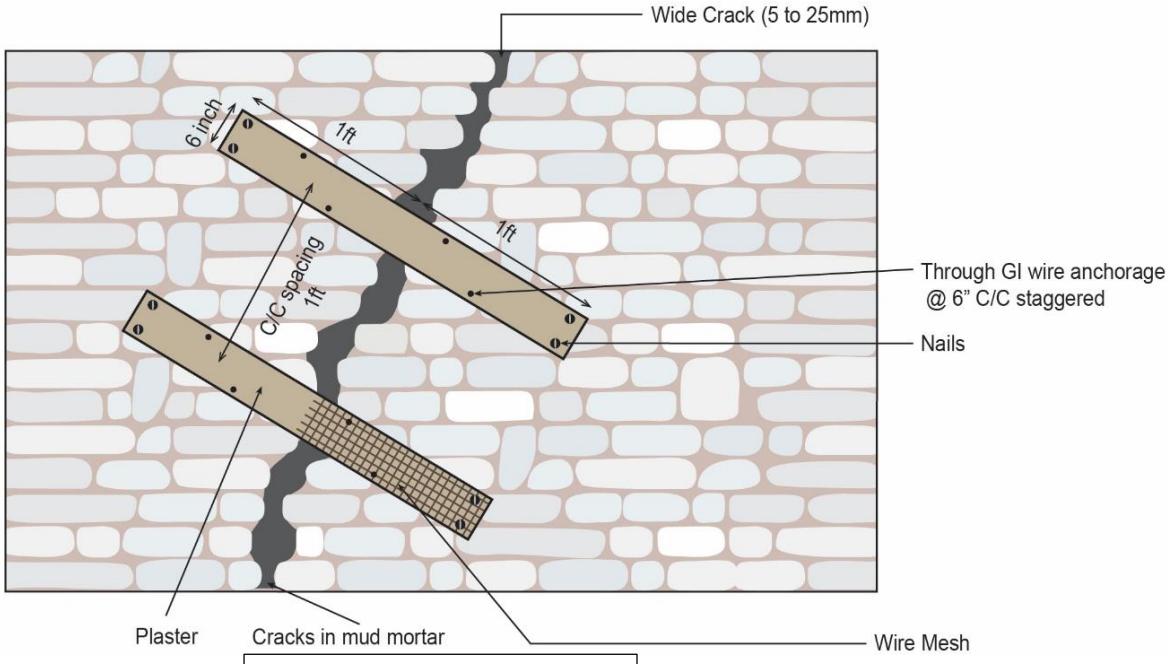
Seal the crack on both faces of the wall with 1:3 ratio cement mortar and allow to gain strength.

Inject the grout from lower most nipple till it comes out from the next higher nipple and then move to next higher nipple.

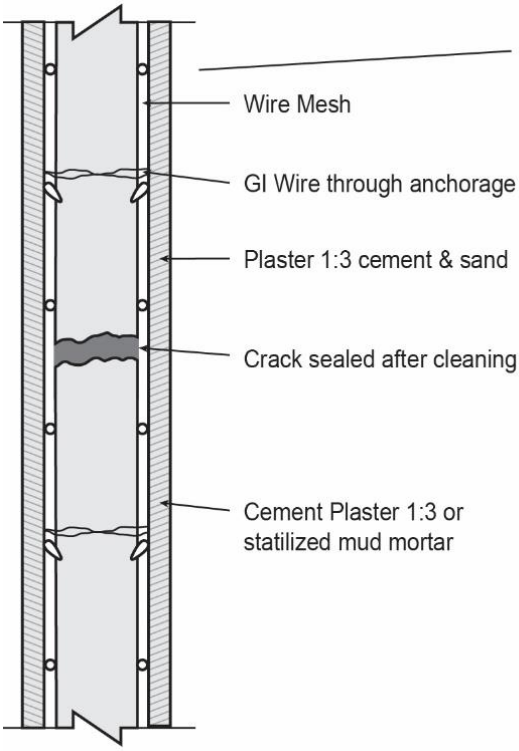
After injection of grout through all the nipples is completed, re-plaster the surface and finish as required.

Material and Equipment

- 1:3 cement-sand mortar for sealing of cracks and plastering.
- Galvanized steel wire mesh (with wires of 16 to 14 gauge i.e. 1.5mm to 2.03 mm diameter) 1 inch x 1 inch mesh size.
- Galvanized steel wire of 12 gauge i.e 3.15 mm diameter, 4 inch long nails.



Stone Masonry : Elevation



Stone Masonry : Section View

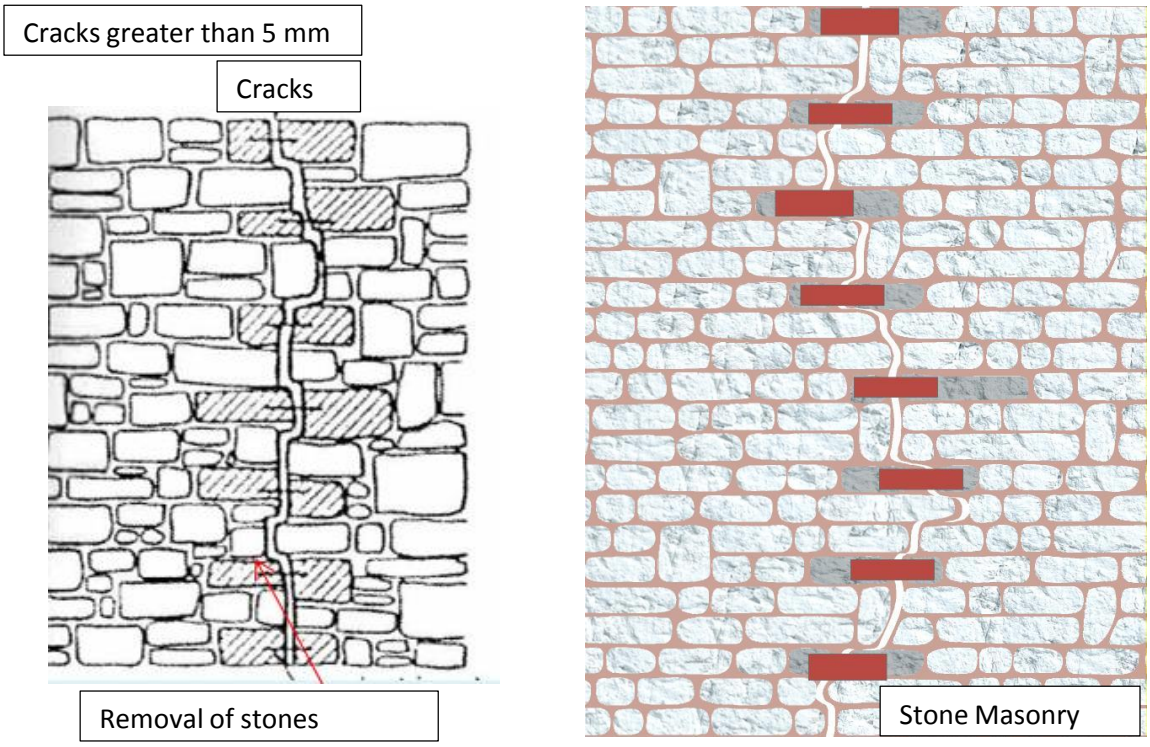
Construction steps:

Steps : Major Cracks (crack width greater than 5 mm) can be repaired by wire mesh as following .

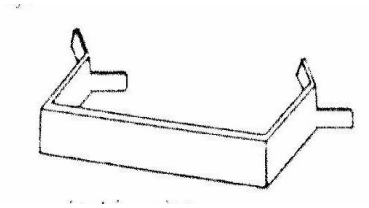
- Remove the plaster in the vicinity of crack exposing the cracked bare masonry upto around 6 inch width at both sides of the crack.
- Make the shape of crack in the V-shape by chiseling out.
- Make the throughout hole on wall by drilling on planned area of wire mesh at spacing of 6" c/c staggered.
- Clean the crack with compressed air.
- Fill the crack with 1: 3 ratio cement mortar with necessary water from both sides as deep as feasible.
- Provide wire mesh on both the faces of wall to a minimum width of 6 inch on each side of the crack and in the entire length of the crack. if it is not possible to provide in the entire length, then provide pieces of wire mesh (width not less than 6 inch) at spacing of about 1 ft.
- Clamp the mesh with the wall using nails.
- Connect the both side of mesh by galvanized wire through the throughout holes of wall.
- Plaster the meshed area with cement sand mortar of 1:3 with minimum of 1/2 inch thickness.

Material and Equipment

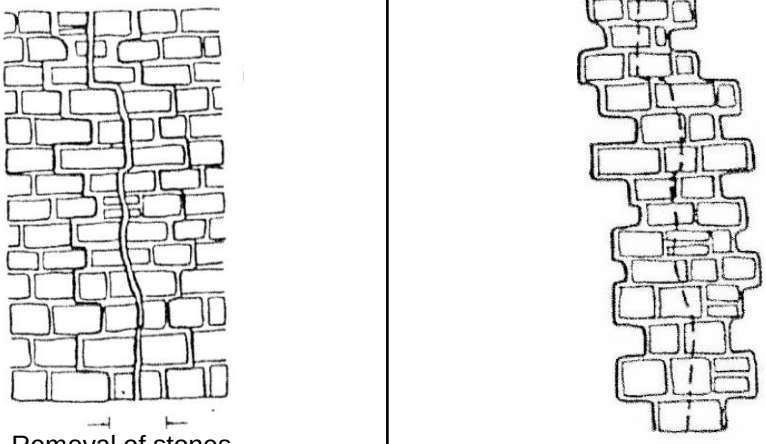
- 1:3 cement-sand mortar for sealing of cracks and plastering.
- Stitching dogs or steel bars with concrete



Stitching up the crack by inserting stitch on both side of wall
(source: UNIDO 1983)



Stitching dog (source: UNIDO 1983)



Stitching up the crack by rebuilding the wall over its entire thickness
(source: UNIDO 1983)

Steps : Major Cracks (crack width greater than 5 mm) can be repaired by stitching as following :

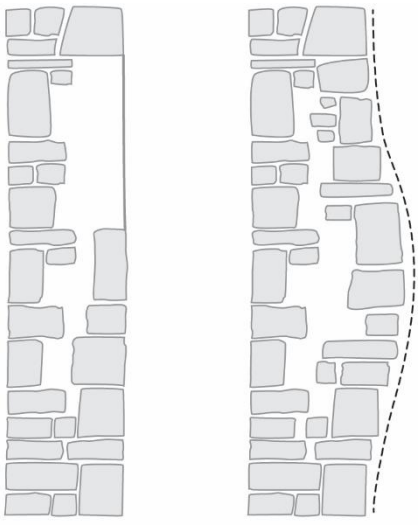
- Remove the plaster in the vicinity of crack exposing the cracked bare masonry upto around 6 inch width at both sides of the crack.
- Make the shape of crack in the V-shape by chiseling out.
- Remove the alternate loose stones adjacent to the cracks.
- Clean the crack with compressed air.
- Add stitching dogs or steel bars with concrete on removed loose stones.
- Alternatively, stones can be removed from a zone about 6" to 9" along a vertical cracks and the wall can be reconstructed using elongated stones.
- Fill the crack with 1: 3 ratio cement mortar with necessary water from both sides as deep as feasible.
- Plaster the exposed area with cement sand mortar of 1:3 with minimum of 1/2 inch thickness.

Material and Equipment

Same as new construction with scaffolding sets

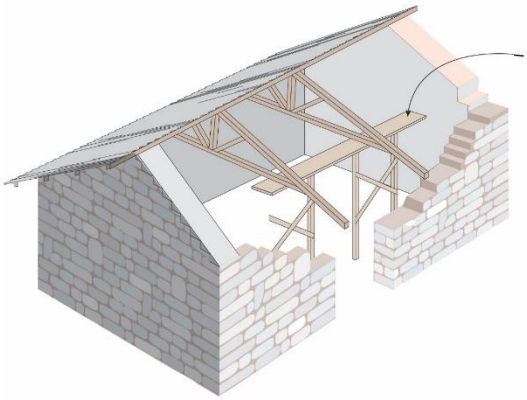
Wall is rebuilt and the void filled with concrete or cement grout

Stone Masonry

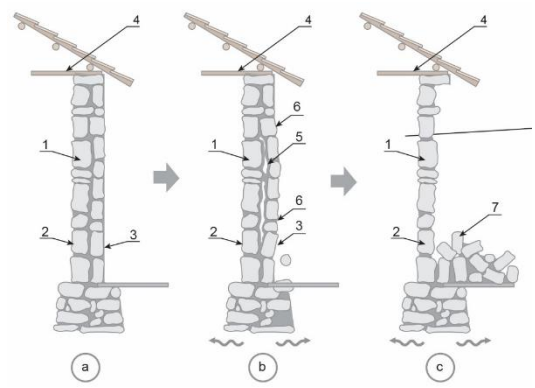


Wall that need completely removed and reconstruction (source: UNIDO 1983)

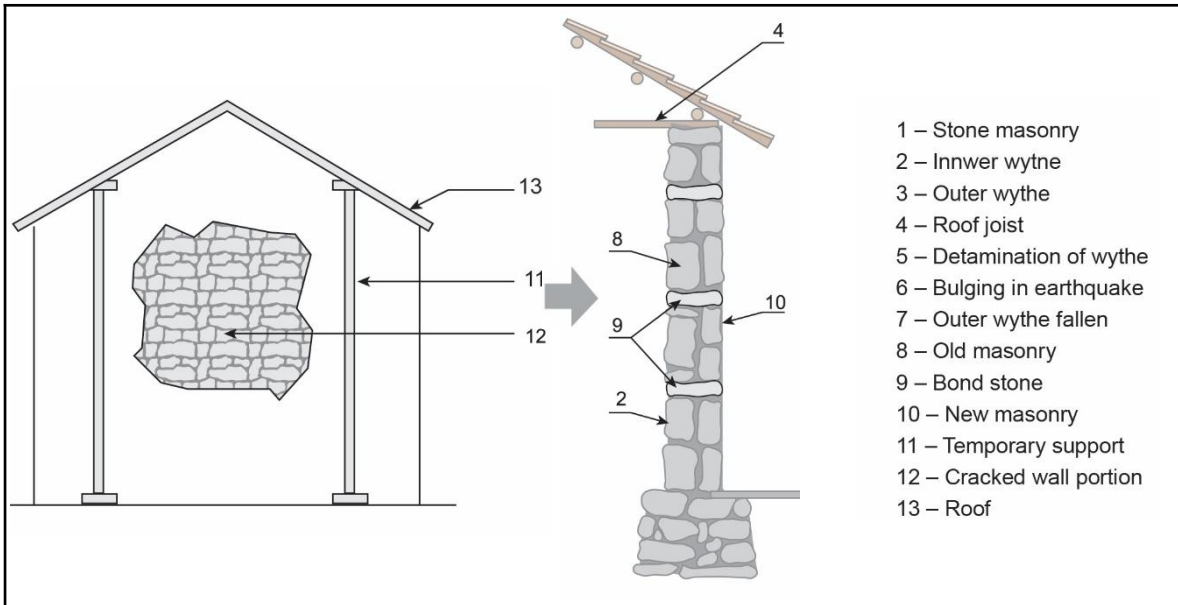
Only humped side need removed and reconstruction (source: UNIDO 1983)



Rebuilding the partial collapsed wall or tilted walls(adapted from:)



1 - Stone masonry
2 - Inner wytne
3 - Outer wythe
4 - Roof joist
5 - Detamination of wythe
6 - Bulging in earthquake
7 - Outer wythe fallen
8 - Old masonry
9 - Bond stone
10- New masonry
11- Temporary support
12- Cracked wall portion
13- Roof



Rebuilding the delaminated wall(source: IAAE 1986)

Steps : Major Cracks (crack width greater than 5 mm) can be repaired by rebuilding as it as following :

- Extensive damage may occur to stone walls which require a portion of the wall to be removed and reconstructed.
- In such case, it is important to promptly install temporary shoring to support the floors and walls above that depends on the extent of damage of wall.
- When portions of the walls have permanent lateral distortion or humping throughout the width of the wall, the distressed portion of the wall must be completely removed and reconstructed.
- If the wall has a spread or humped on only one face, complete reconstruction can be avoided if the vertical face is stable enough to be used as formwork after the humped side has been taken down. Header are placed in the rebuilt wall using concrete or cement grout to completely fill all voids.
- The new portion of the wall should be constructed using the same mortar as that used in the existing construction.

a) General retrofitting process

- Following gives over view of construction steps, activities and description of retrofitting process.

Steps	Activities	Description
1	Remove plaster	Plaster removed from walls in the area only where splint and bandage is to be added, dust cleaned, any holes patched up for consistent wall surface. Mud mortar raked to 25mm in case of mud mortar and 12 mm to 15 mm in case of cement plaster.
2	Clean, repair and prepare walls	Cracks cleaned with water and grouted, thin cement slurry for cement based construction or mud (mud-cement mix) for mud based construction, applied over the area of wall where splint and bandage is to be added with water bottle.
3	Excavate tie beam	Excavation as per drawing, soling installed to correct level. Foundation wall brushed and washed with water to remove all mud.
4	Tie beam ties installed	Holes drilled or cavities located as per required spacing, reinforcement installed as per diagram to length of half of wall width plus 50mm (2").
5	Tie beam ties grouted	Grout all reinforcement ties using 1:3 mortar mix, firm in place.
6	Install splint and bandage	GI wire ties placed as per required spacing. Wire mesh rolled horizontally, with corners of room at the middle of the panel. Wire mesh secured in place with tightened loops of GI wire ties, wire mesh panels bound together using binding wire with 50mm (2") overlap.
7	Demolish walls and replace frames	Replace any damaged timber frames and install new lintel.
8	Reconstruct wall, truss mounts, bracing mounts, install jacketing	Wall constructed using stone and mud to 2400mm (8'), installing wire ties and wire mesh as height increases. 20mm pipe 600mm long (2') for bracing brackets installed in corners and centre of long walls (total 6 per classroom) for bracing bolts.. Leave 300mm x 300mm (1'x1') gaps at top of wall where trusses will be mounted.
9	Truss mounts	Fill 300mm x 300mm (1'x1') gaps in wall with stones /concrete, cast GI wire ties and fold wire mesh on both sides of wall across the top of wall. Cast 4x 10mm bars 600mm (2') long. 2 bars on each side of where truss beam will be located, 150mm (6”) apart or as required depending on timber width.

10	Secure wire mesh, install reinforcement	Wire mesh installed tight against stone wall, wire tie loops tightened and tied, corners of wire mesh flattened, and tie beam anchors tight, 12mm dia rod in place with lap lengths 500 mm. Install vertical reinforcement at splint location midway along external end walls as per drawing. Formwork constructed for tie beam, tight with no leaks.
11	Concrete tie beams	Concrete tie beams with 1:1.5:3 concrete mix. Ensure good compaction using rod. When hardening fill hole with water or cover with wet jute immediately, cover with material or tarpaulin for shade to prevent evaporation.
12	Plastering internal	Plastering to inner walls using 1:3 mortar mix. Plaster applied in two layers. Ensure depth and good bond with wall. To depth 30mm or 20mm where specified in drawings. Smooth finish. Stop near top of wall. Upon completion cover with wet jute material and tarpaulin to stop evaporation. Apply water to jute several times a day or as needed to maintain wetness.
13	Plastering external	Plastering to outer walls using 1:3 mortar mix. Plaster applied in two layers. Ensure depth and good bond with wall. To depth 30mm as specified in drawings, and 50mm thickness at splint location as per drawing. Smooth finish. Stop near top of wall. Upon completion cover with wet jute material and tarpaulin to stop evaporation. Apply water to jute several times a day or as needed to maintain wetness.
14	Plaster top of wall	Plaster top of wall to minimum 50mm thickness using 1:3 mortar mix or micro concrete 1:1.5:3 mix as advised by technical supervisor. Upon completion cover with wet jute material and tarpaulin to stop evaporation. Apply water to jute several times a day or as needed to maintain wetness.
15	Roof installed	Roof truss timber cut, fabricated, placed and secured. Truss constructed as per drawing.
16	Install bracing	Install bracing.

Annex 1 : Typical structural drawings

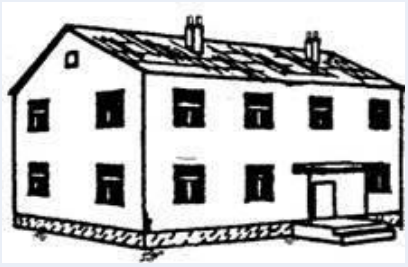
[Annex 1 is compiled in A3 sheets, separate volume which is detail retrofitting drawings for type design of particular buildings. Further structural drawing can be prepared for ready to use designs presented in Part : C with study of these drawings. The drawing are of following building typologies:

- Retrofitting Stone masonry building
  1) Retrofitting stone masonry building in mud (RSMM)
  2) Retrofitting dry stone masonry building (RDSM)

- Retrofitting brick masonry building
  1) Retrofitting brick masonry building in mud with flexible floor (RBMM)
  2) Retrofitting brick masonry building in cement with flexible floor (RBMC1)
  3) Retrofitting brick masonry building in cement with rigid floor (RBMC2)

[Note:] : The preparation of detail drawing shall not be mandatory where ready to use design are applicable. In case of detail design submitted, only typical drawing shall be prepared.

Annex 2 : EMS Damage Grade

Classification of damage to masonry buildings	
 Grade 1: Negligible to slight damage	Structural damage : No Non-structural damage: Slight • Hair-line cracks in very few walls. • Fall of small pieces of plaster only. • Fall of loose stones from upper parts of buildings in very few cases.
 Grade 2: Moderate damage	Structural damage : Slight Non-structural damage: Moderate • Cracks in many walls. • Fall of fairly large pieces of plaster. • Partial collapse of chimneys.
 Grade 3: Substantial to heavy damage	Structural damage: Moderate Non-structural damage: Heavy • Large and extensive cracks in most walls. • Roof tiles detach. • Chimneys fracture at the roof line; failure of individual non-structural elements (partitions, gable walls).
 Grade 4: Very heavy damage	Structural damage: Heavy Non-structural damage: Very heavy • Serious failure of walls; partial structural failure of roofs and floors.
 Grade 5: Destruction	Structural damage: very heavy • Total or near total collapse.

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नेपाल सरकार
राष्ट्रिय पुनर्निर्माण प्राधिकरण
आवास पुनर्निर्माण कार्यक्रम
सिंहदरबार, काठमाडौं
फोन नं.: ०१४२००२६६, ४२१११०३
इमेलः info@nra.gov.np

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN ON THREE STOREY BRICK MASONRY BUILDING IN CEMENT USING RC BARS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

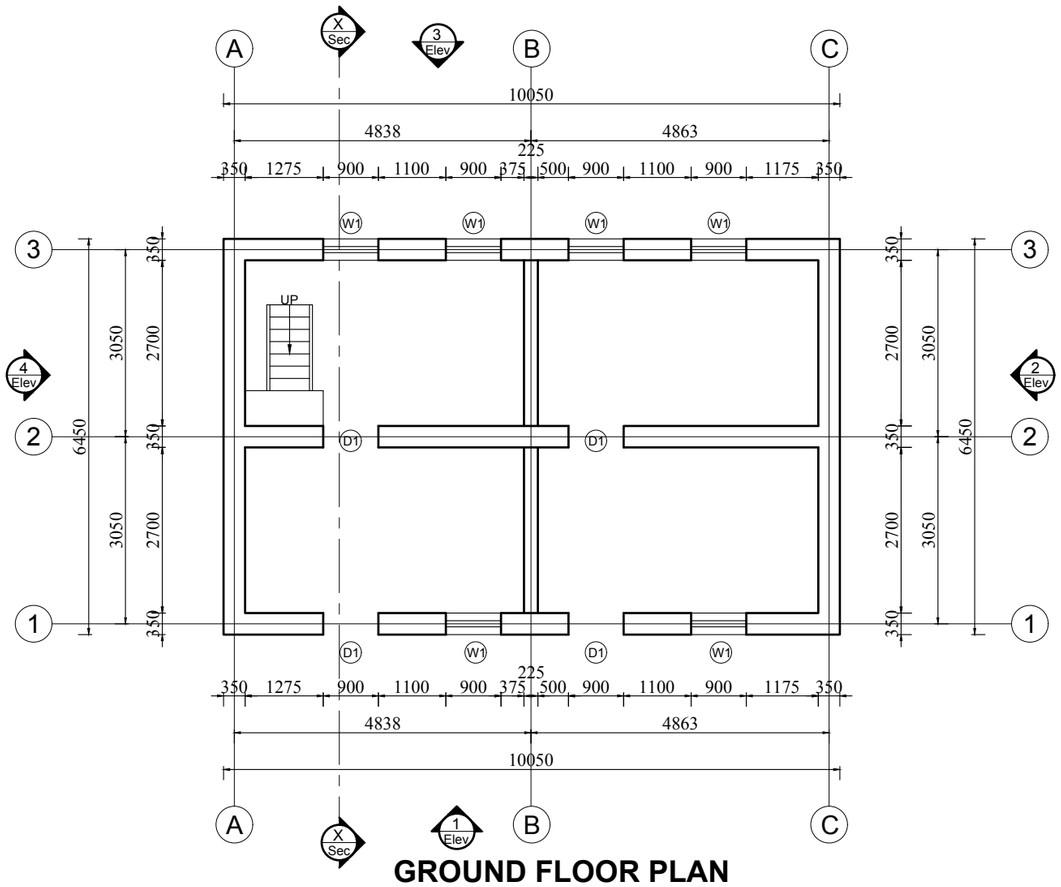
SHEET TITLE :-

COVER PAGE

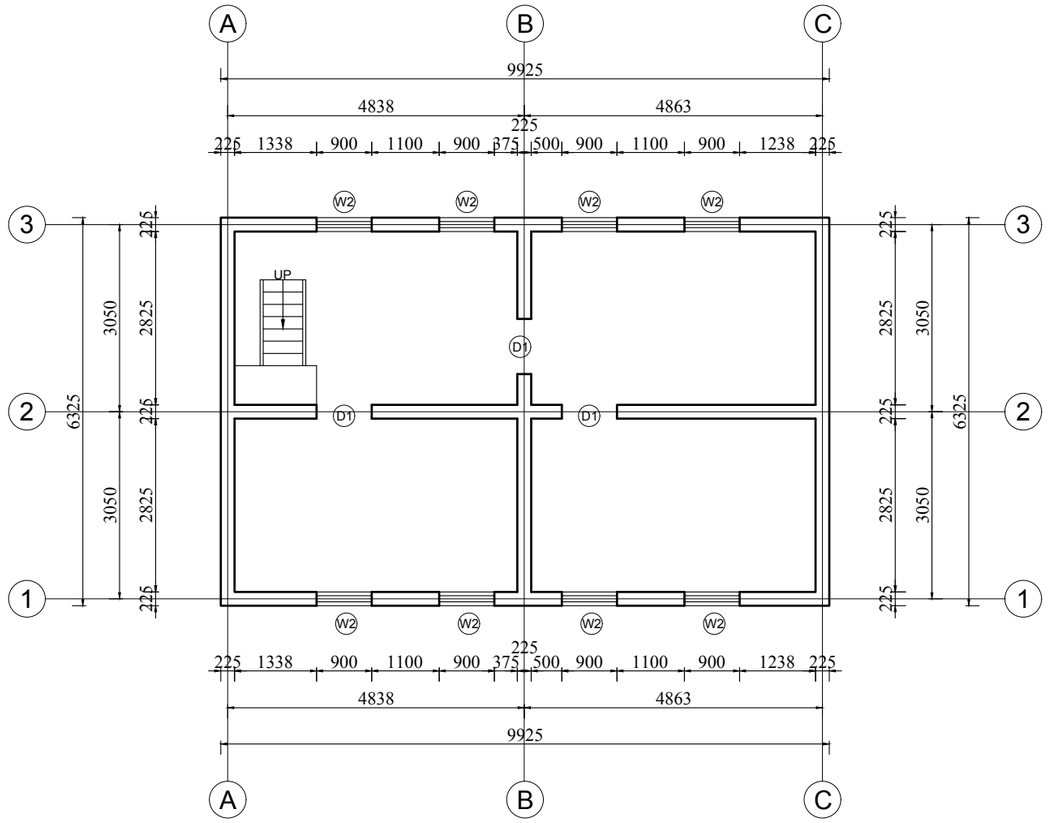
SCALE :- N/A

DATE :- JULY, 2017

0



GROUND FLOOR PLAN



FIRST AND SECOND FLOOR PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

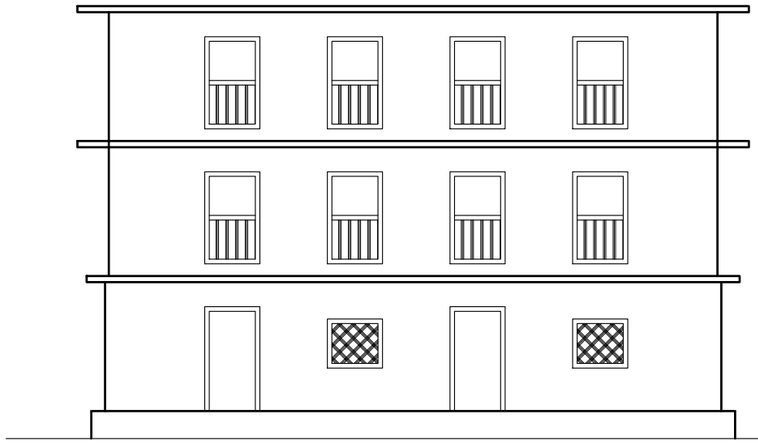
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

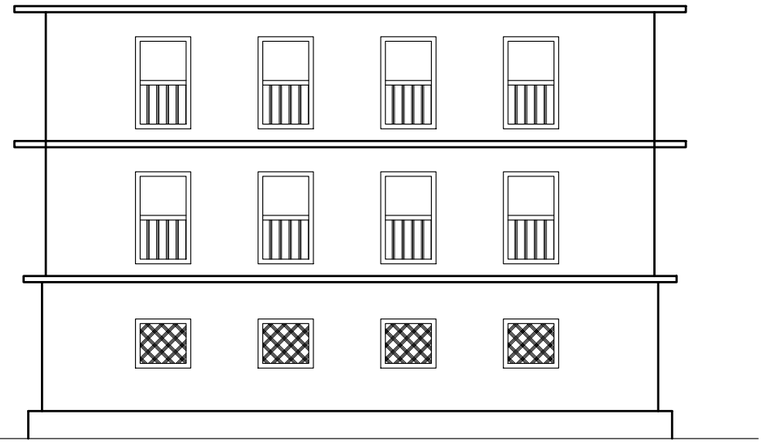
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

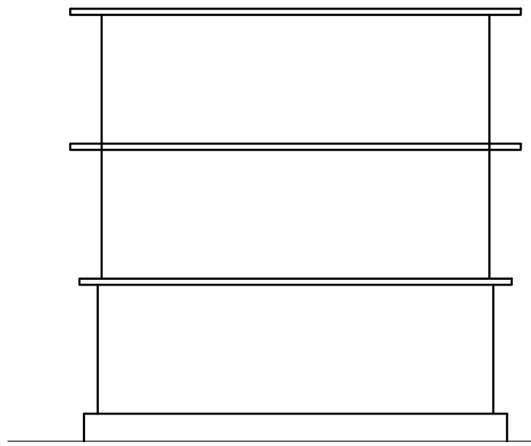
01



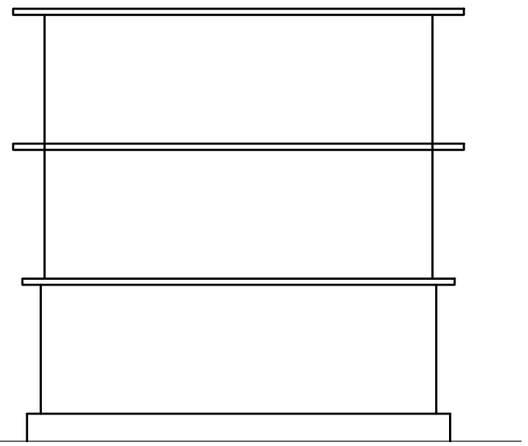
ELEVATION-1



ELEVATION-3



ELEVATION-2



ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING

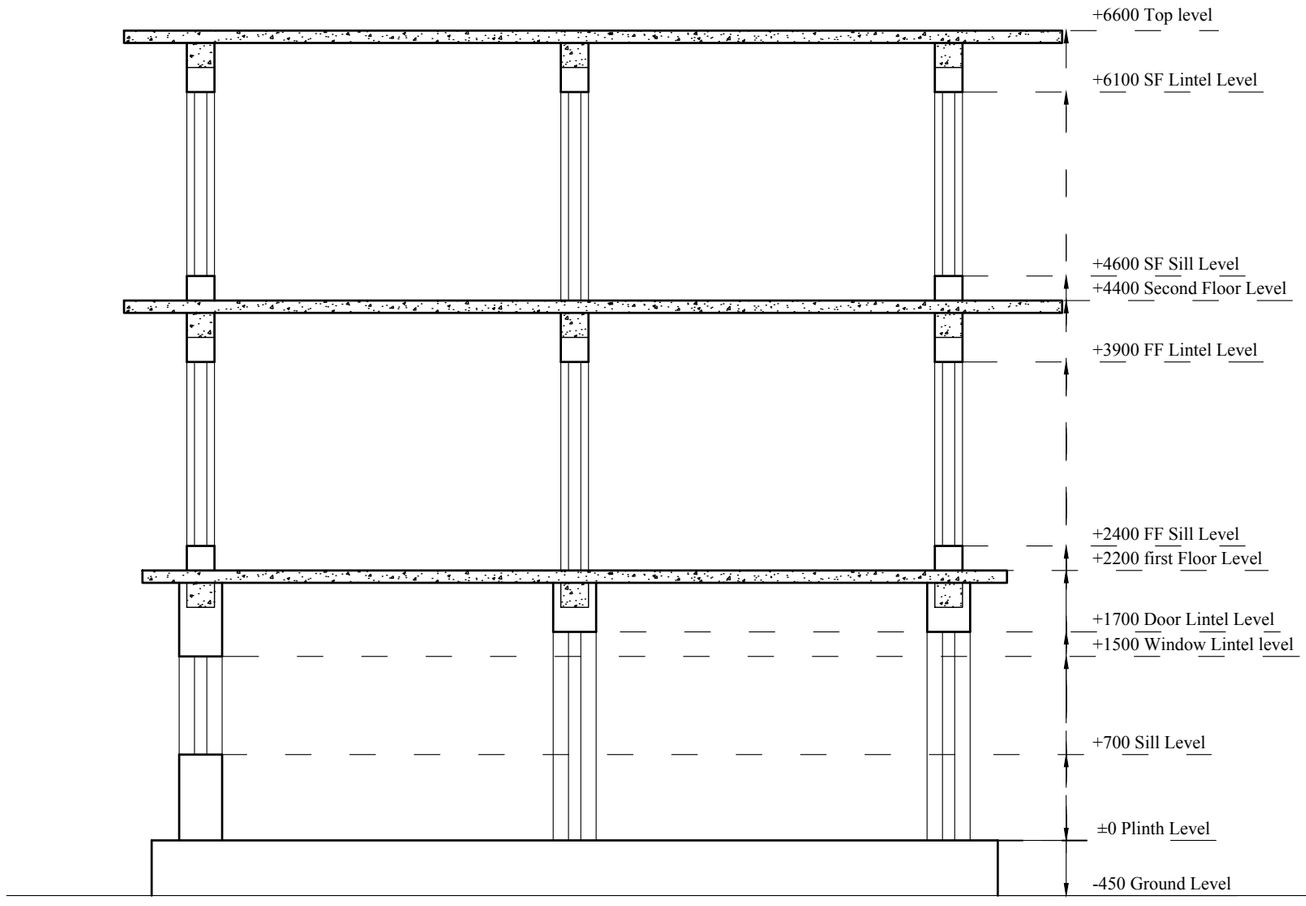
02

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

OPENING SCHEDULE

S.N.	SYMBOL	NOS.	SIZE	SILL HEIGHT
1.	DOOR-D	10	900 x 1700	---
2.	WINDOW-W1	6	900 x 800	700
3.	WINDOW-W2	16	900 x 1500	200



SECTION AT X-X

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

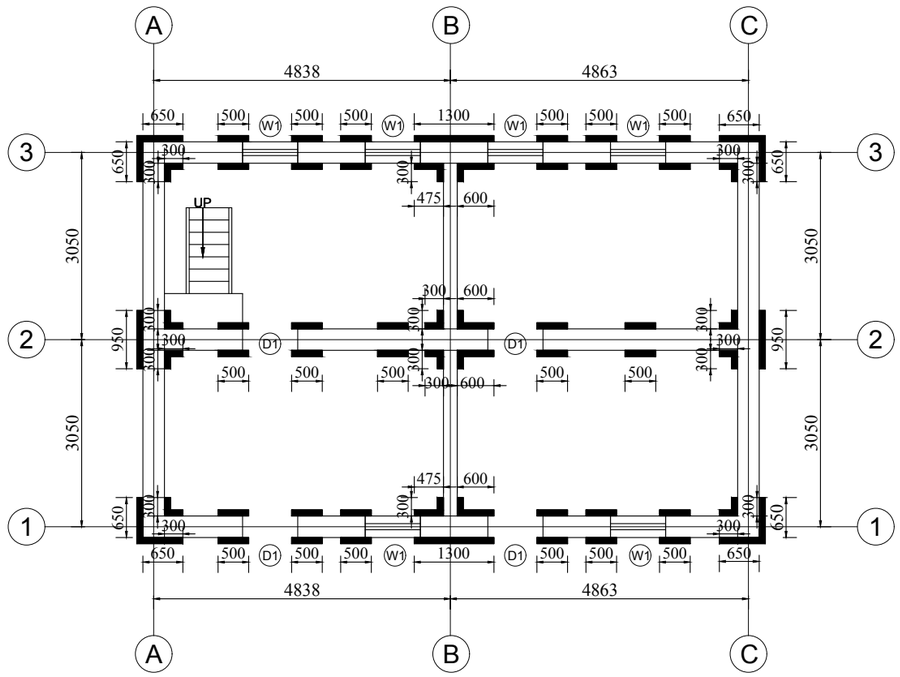
SHEET TITLE :-

SECTION OF EXISTING BUILDING AND DETAILS

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

03

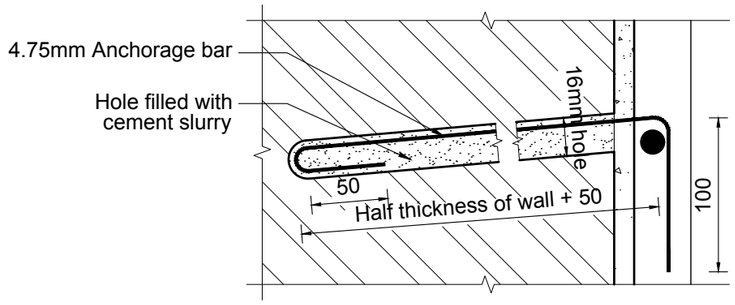


GROUND FLOOR PLAN SHOWING TIE BEAM FOR SPLINT ON WALLS

SCALE = 1:100

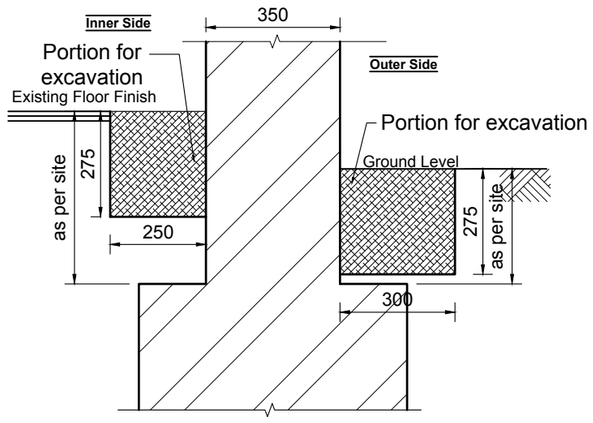
Notes:

Tie beam for Splint on walls using RC Bars of 10mmØ



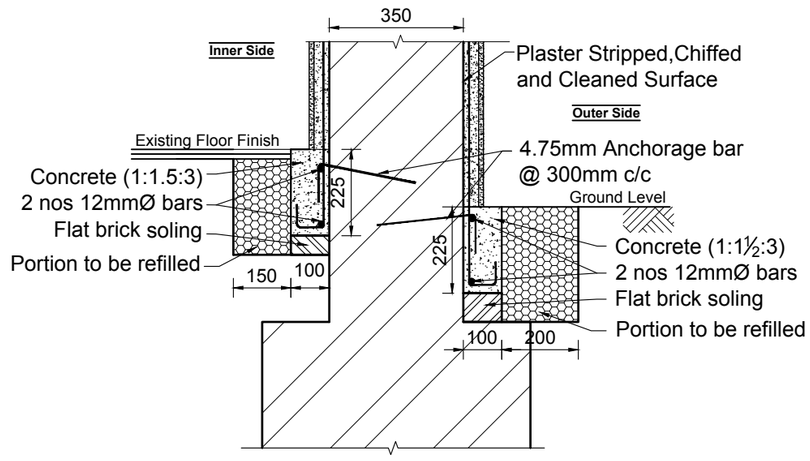
4.75 MM ANCHORAGE BAR DETAILS

SCALE 1:4



SECTION SHOWING THE PORTION TO BE EXCAVATED FOR TIE BEAM

SCALE = 1:16



DETAILS OF TIE BEAM (FOR RC BARS) FOR INNER AND OUTER SIDE OF THE WALL

SCALE = 1:16

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

SHEET TITLE :-

TIE BEAM AND DETAILS

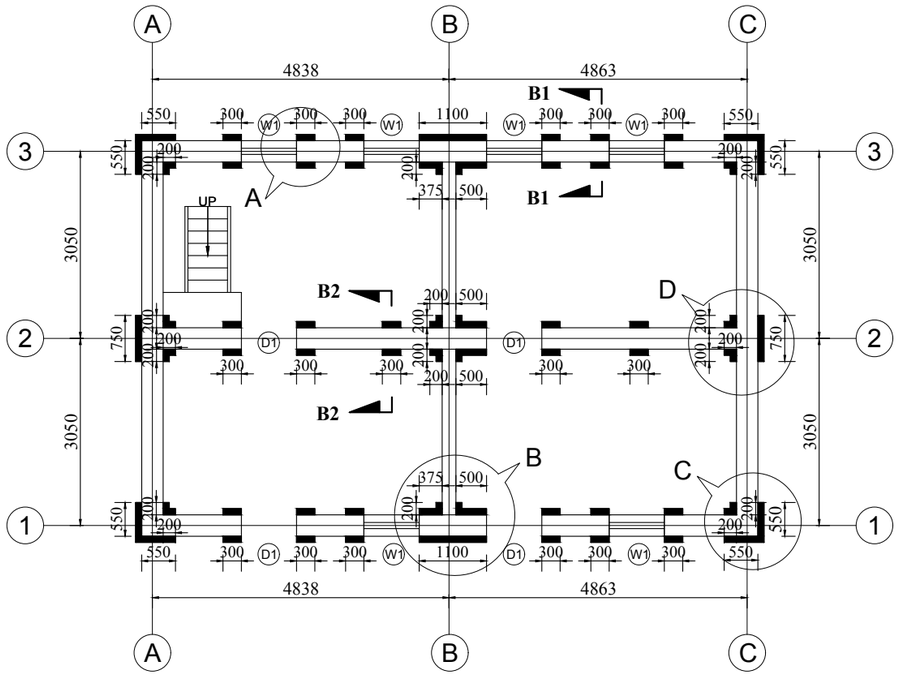
SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

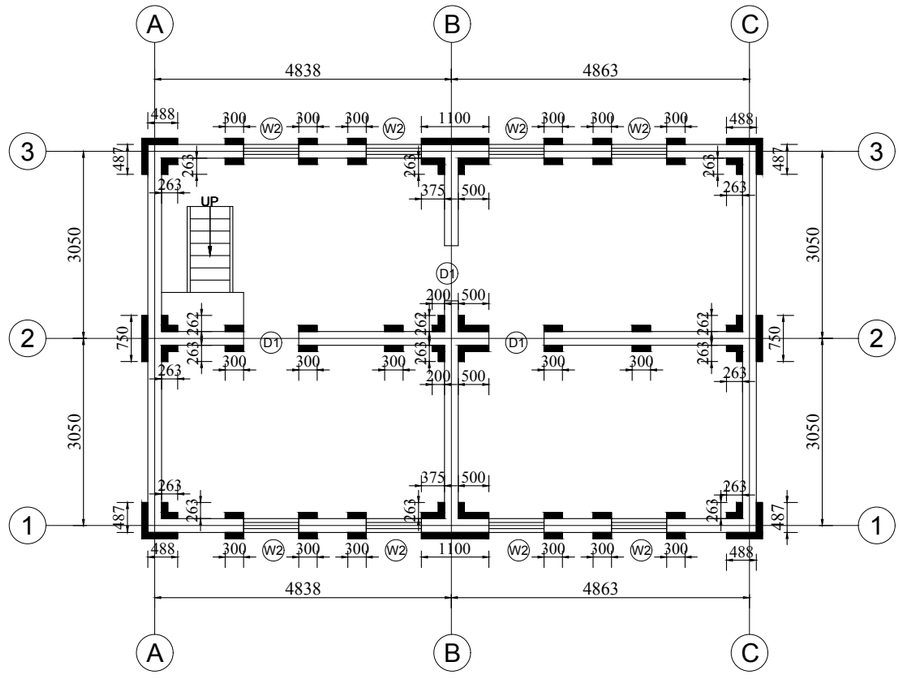
04

Notes:

Splint
200mm width on each sides of corners and junctions using 3-10mmØ bars
300mm width for sides of openings and on walls using 3-10mmØ bars



GROUND FLOOR PLAN SHOWING LOCATION OF SPLINT ON WALLS



FIRST AND SECOND FLOOR PLAN SHOWING LOCATION OF SPLINT ON WALLS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

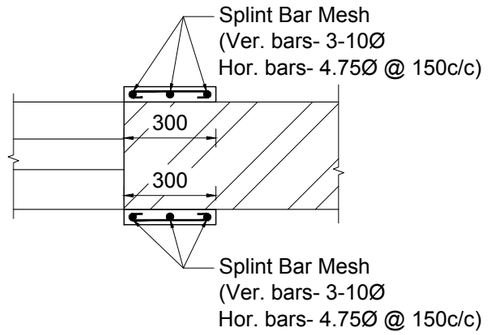
SHEET TITLE :-

FLOOR PLANS SHOWING LOCATION OF SPLINT ON WALLS

SCALE :- 1:100 FOR A3 PAPER

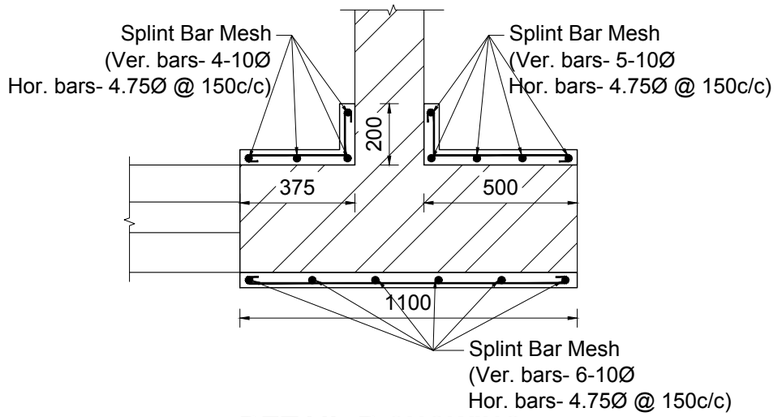
DATE :- JULY, 2017

05



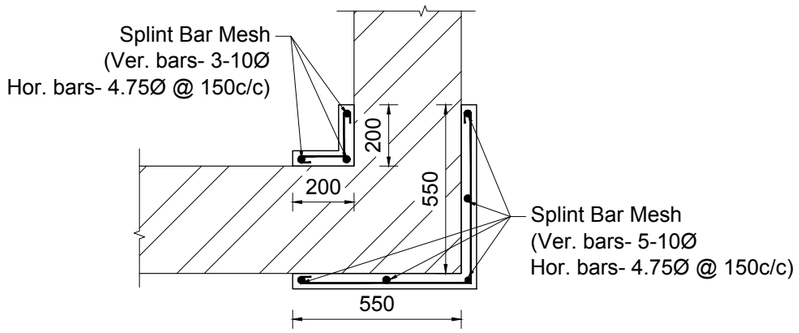
DETAIL-A SHOWING
VERTICAL SPLINT AT SIDES OF OPENING

SCALE = 1:20



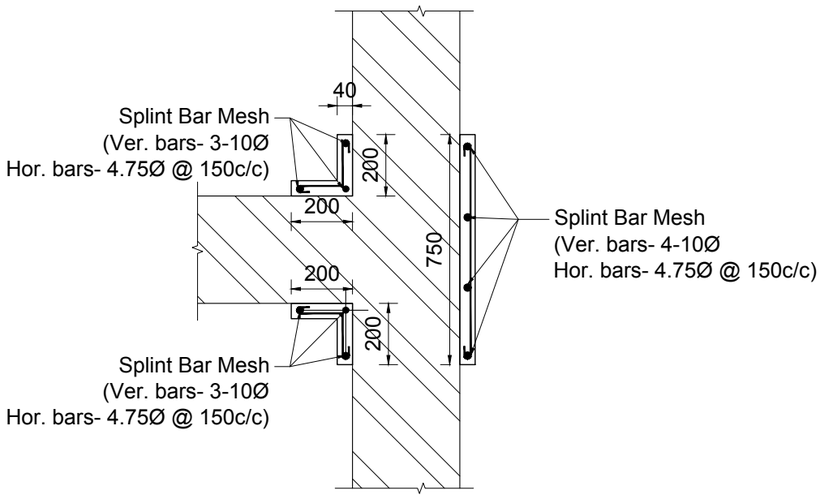
DETAIL-B SHOWING
VERTICAL SPLINT AT JUNCTION

SCALE = 1:20



DETAIL-C SHOWING
VERTICAL SPLINT AT CORNER

SCALE = 1:20



DETAIL-D SHOWING
VERTICAL SPLINT AT JUNCTION

SCALE = 1:20

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

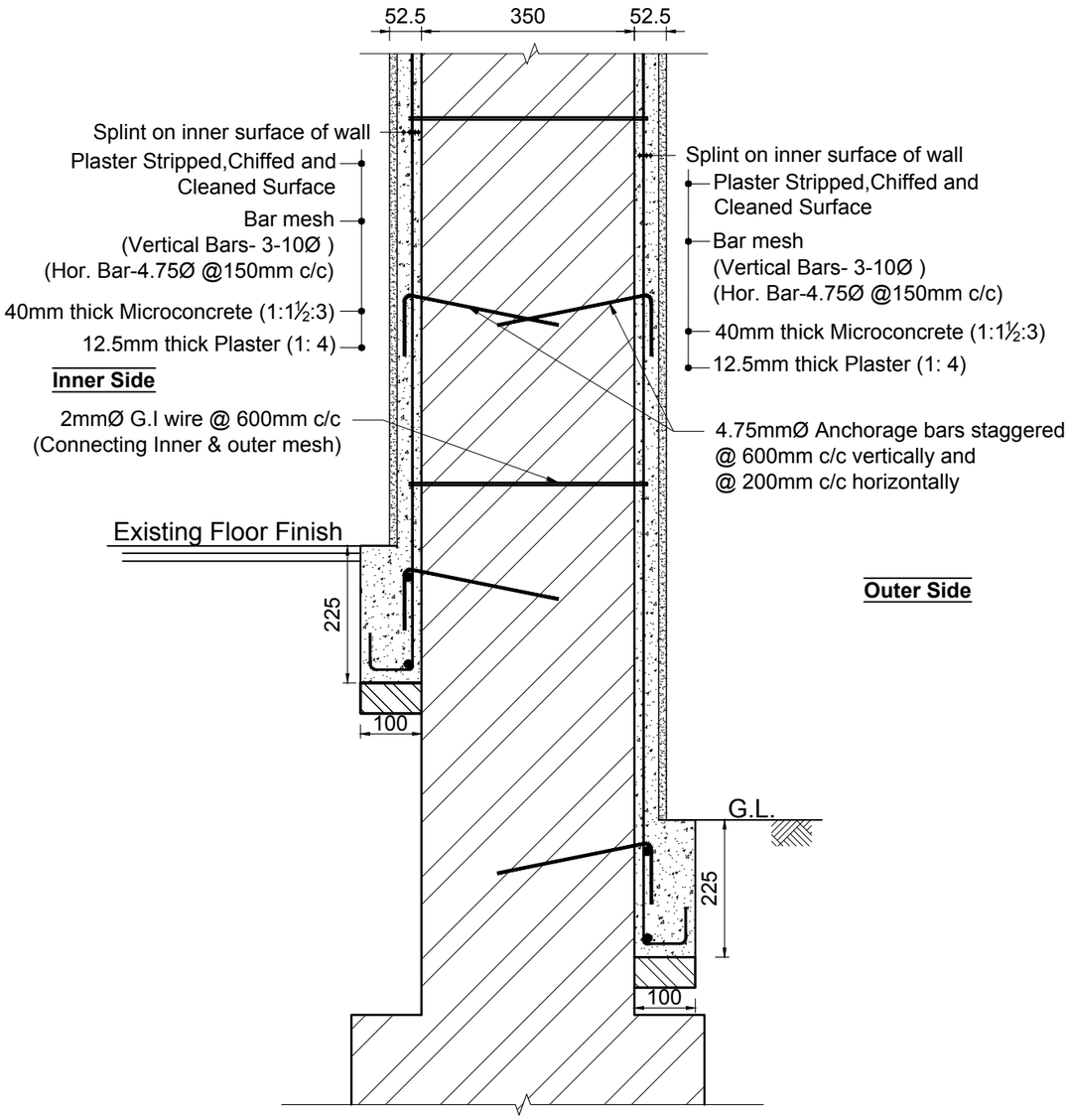
SHEET TITLE :-

DETAILS OF SPLINT

SCALE :- 1:20 FOR A3 PAPER

DATE :- JULY, 2017

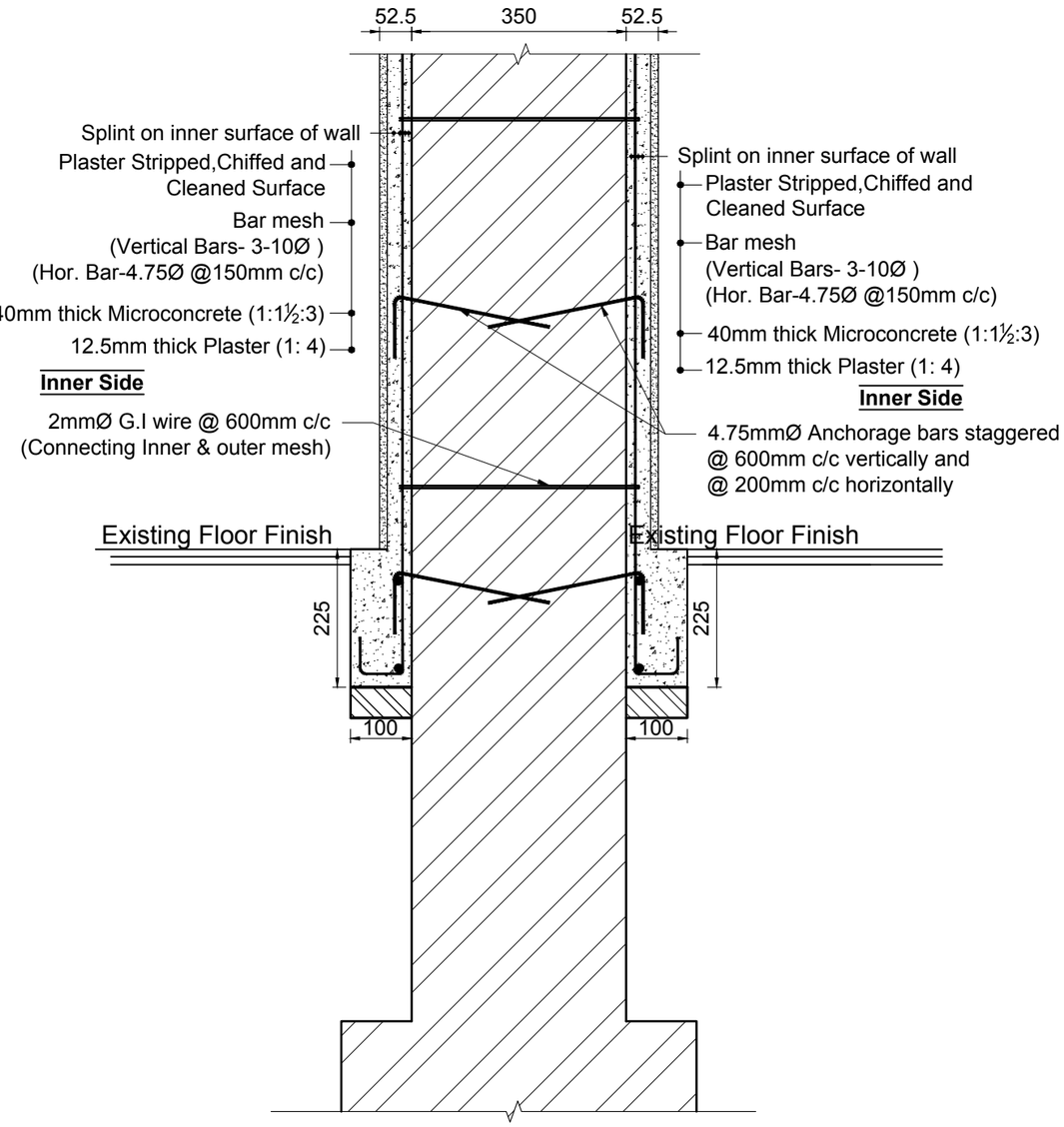
06



SECTION AT B1-B1

(DETAILS OF SPLINT ON BOTH SURFACES OF INTERNAL WALLS)

SCALE = 1:10



SECTION AT B2-B2

(DETAILS OF SPLINT ON BOTH SURFACES OF INTERNAL WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

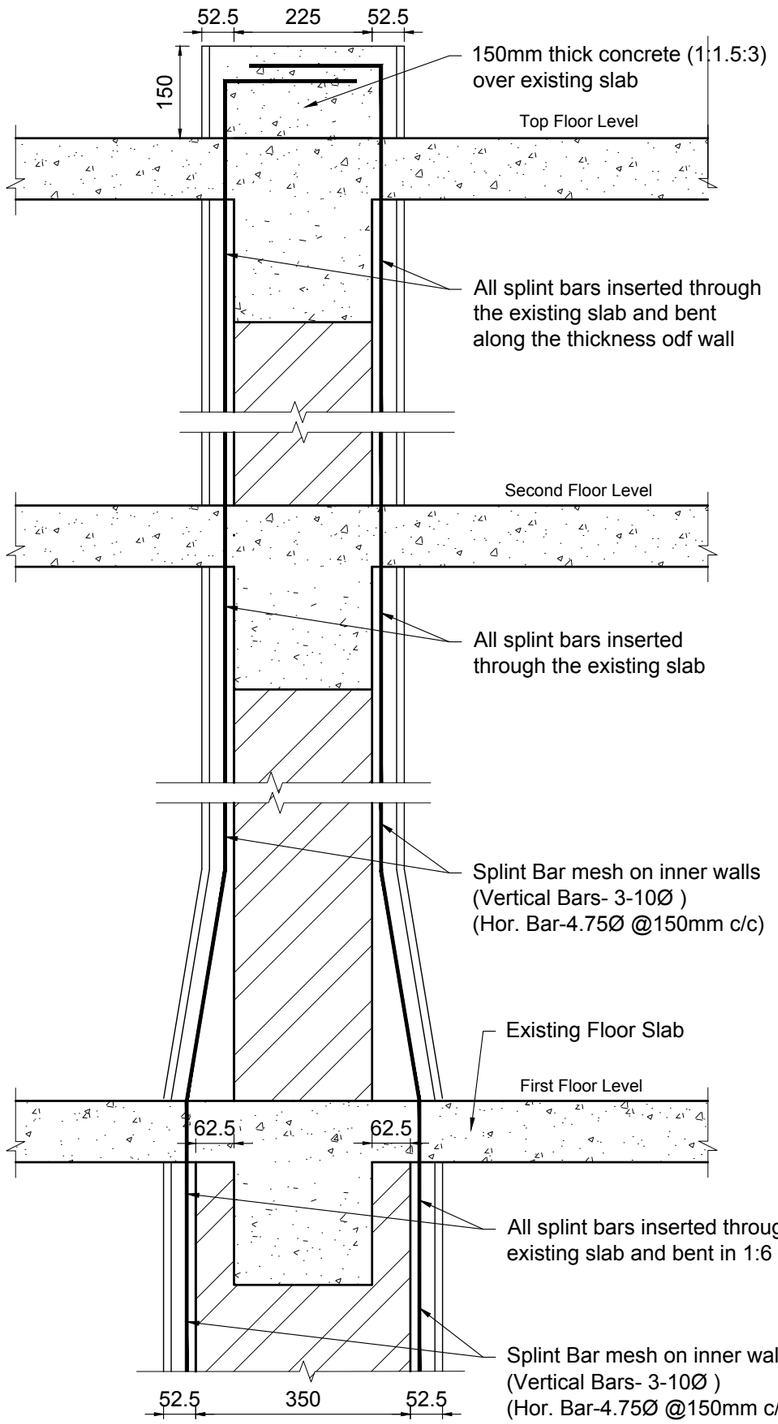
SHEET TITLE :-

DETAILS OF SPLINT

SCALE :- I:10 FOR A3 PAPER

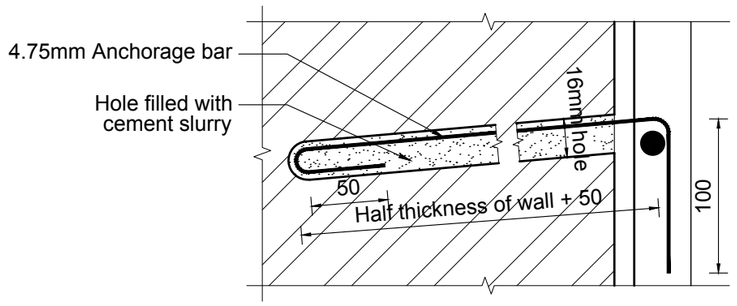
DATE :- JULY, 2017

07



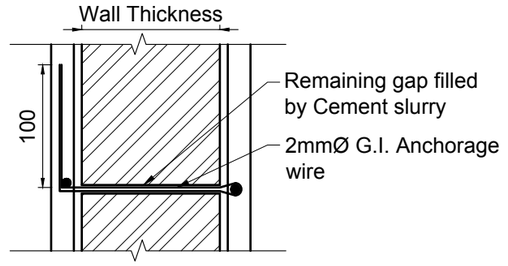
TYPICAL SECTION SHOWING ANCHORAGE OF VERTICAL BARS WITH FLOOR SLAB ON WALLS

SCALE = 1:10



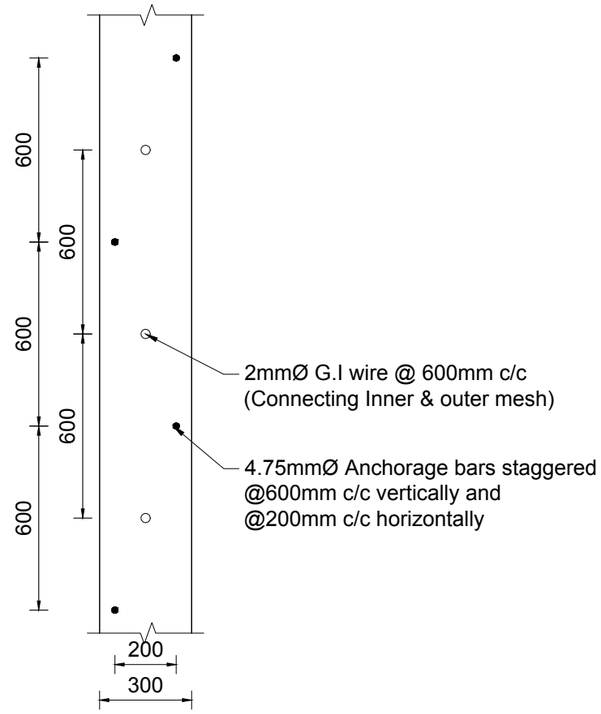
ANCHORAGE BAR DETAILS

SCALE 1:4



G.I. WIRE DETAILS

SCALE 1:10



LAYOUT OF ANCHORAGE BARS FOR CONNECTING SPLINT BANDS ON BOTH SIDES OF WALLS

SCALE 1:20

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

SHEET TITLE :-

DETAILS OF SPLINT

SCALE :- 1:20, 1:10, 1:4 FOR A3 PAPER

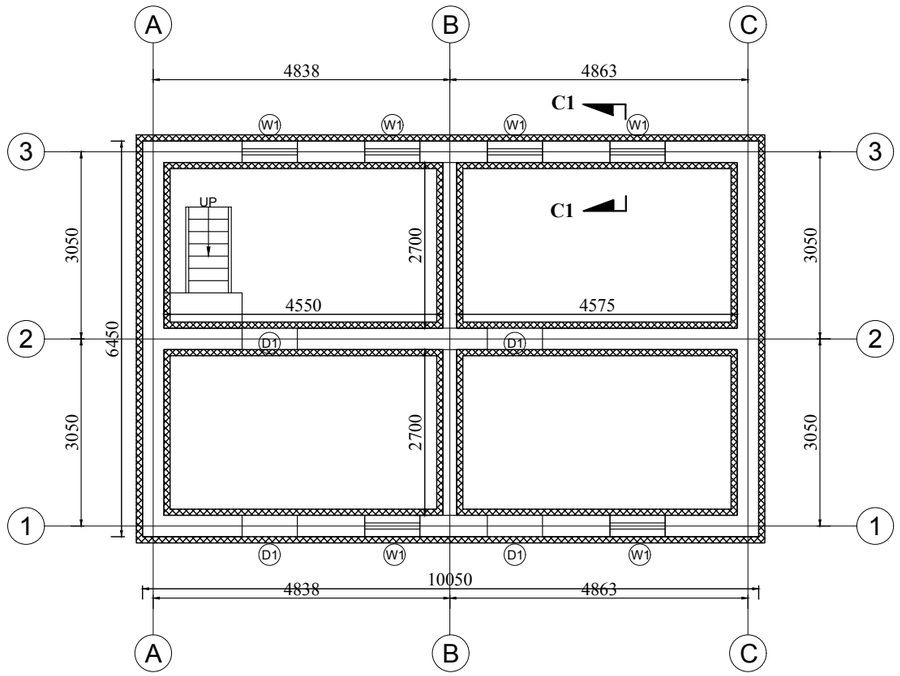
DATE :- JULY, 2017

08

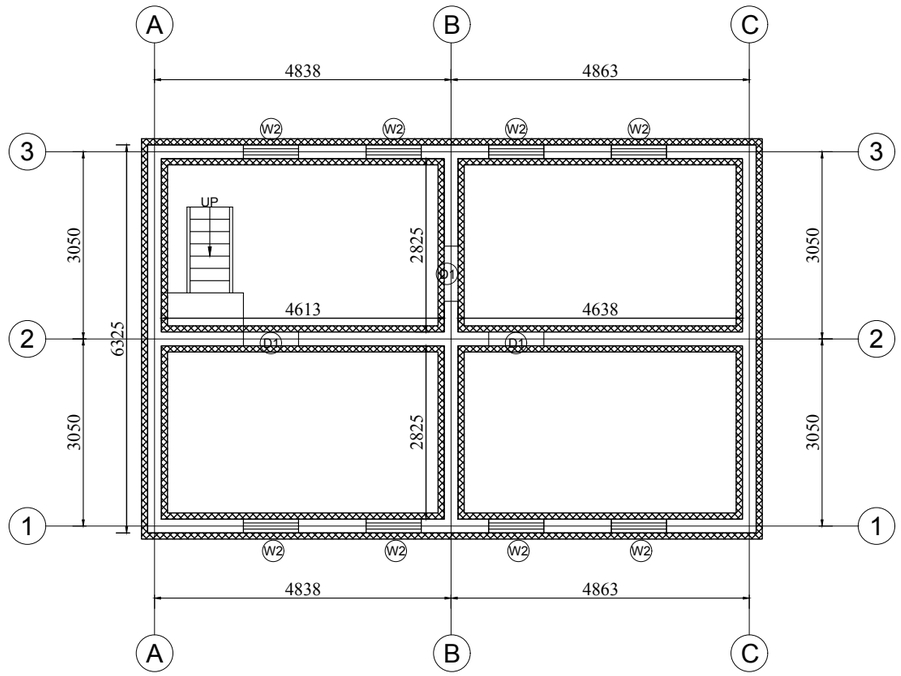
Notes:

Horizontal Bands

- 200mm width using 2-4.75mmØ bars at mid level
- 300mm width using 2-4.75mmØ + 1-8mmØ bars at lintel level



GROUND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



FIRST AND SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS

PROJECT TITLE :-

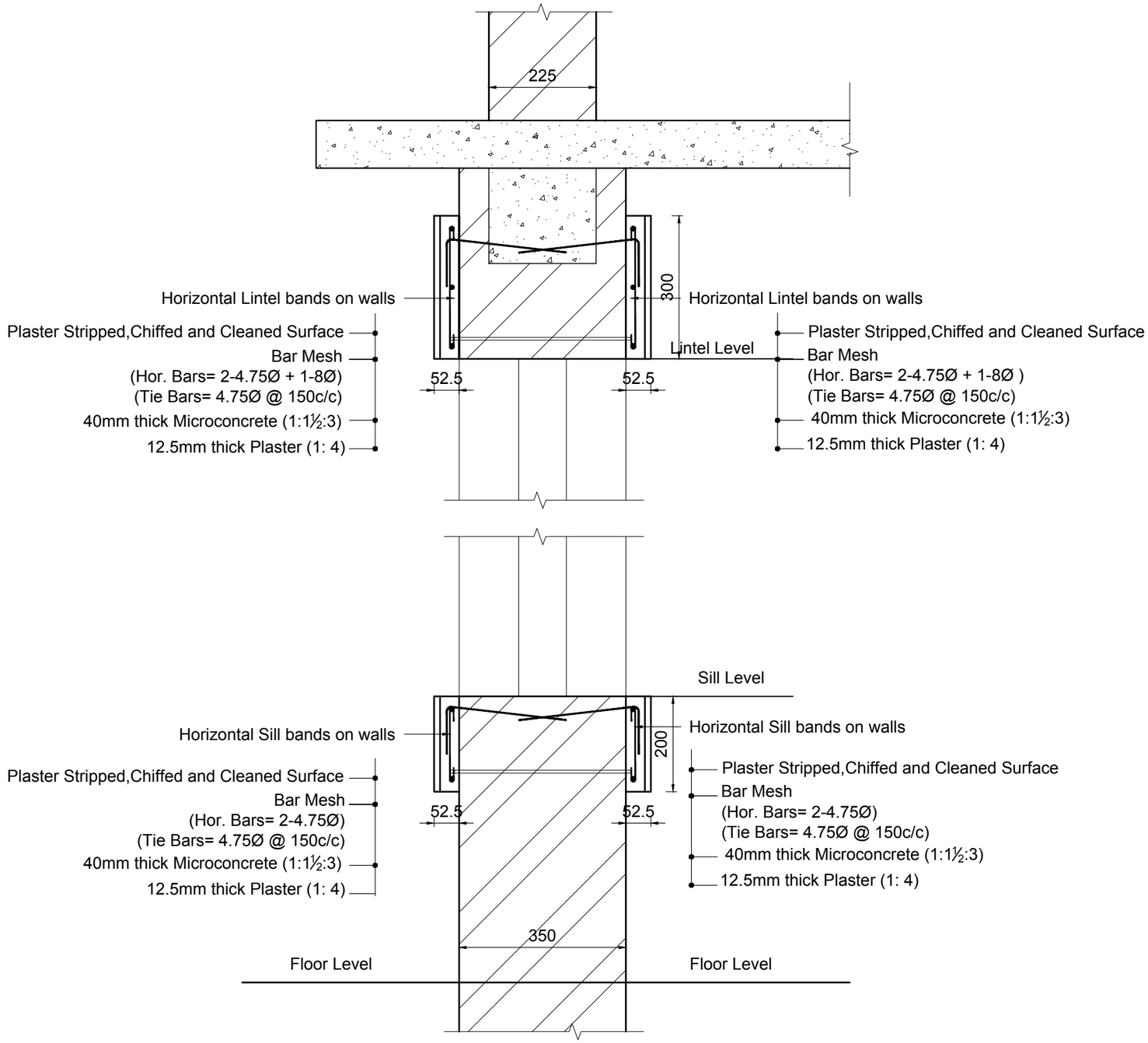
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

SHEET TITLE :- FLOOR PLANS SHOWINGLOCATIONS OF HORIZONTAL BANDAGES AT FLOOR AND SILL LEVEL

09

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017



SECTION AT C1-C1

(DETAILS OF HORIZONTAL BANDAGES
ON BOTH SURFACES OF WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

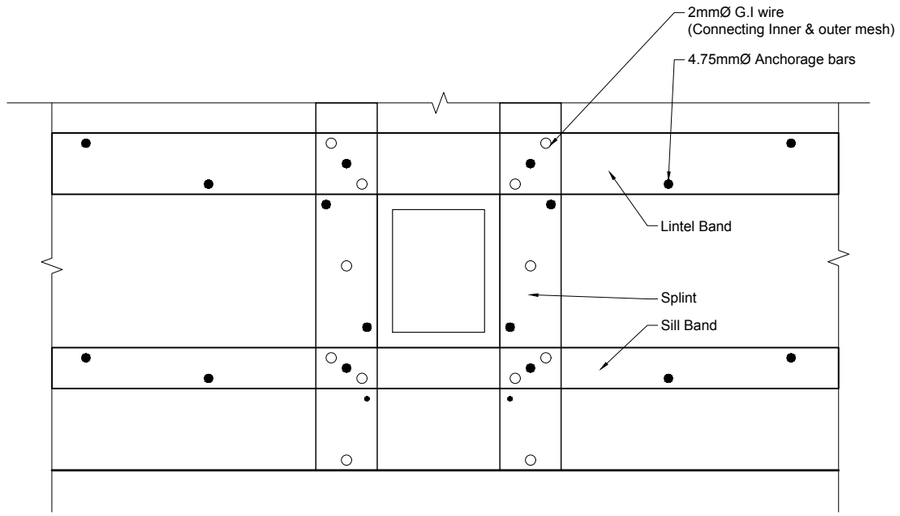
SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- 1:10 FOR A3 PAPER

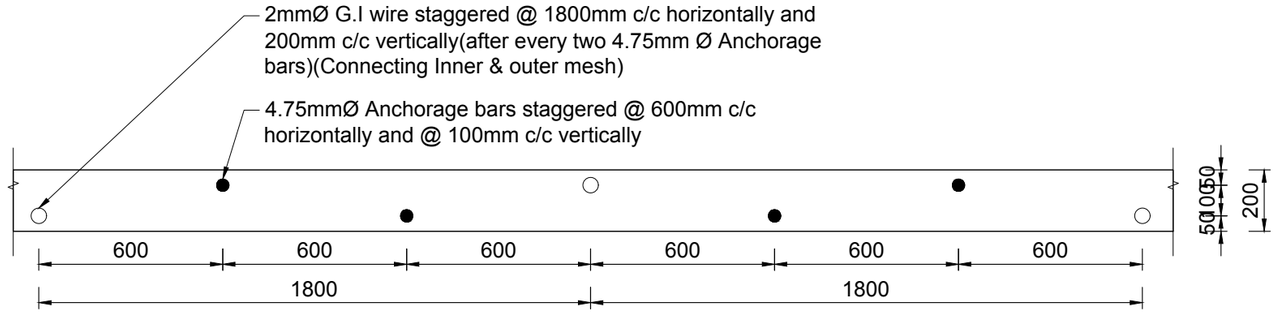
DATE :- JULY, 2017

10



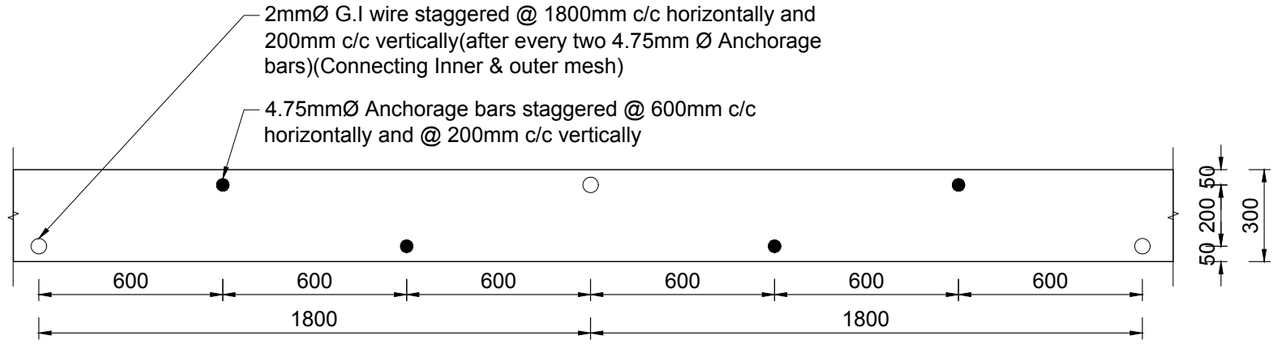
TYPICAL LAYOUT OF ANCHORAGE FOR CONNECTING SPLINT AND HORIZONTAL BANDAGE ON BOTH SIDES OF WALLS

SCALE 1:30



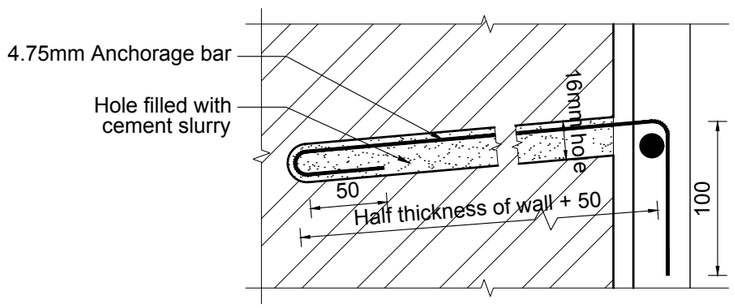
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT SILL/MID LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



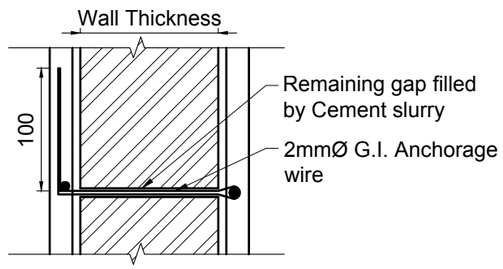
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT LINTEL LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



ANCHORAGE BAR DETAILS

SCALE 1:4



G.I. WIRE DETAILS

SCALE 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

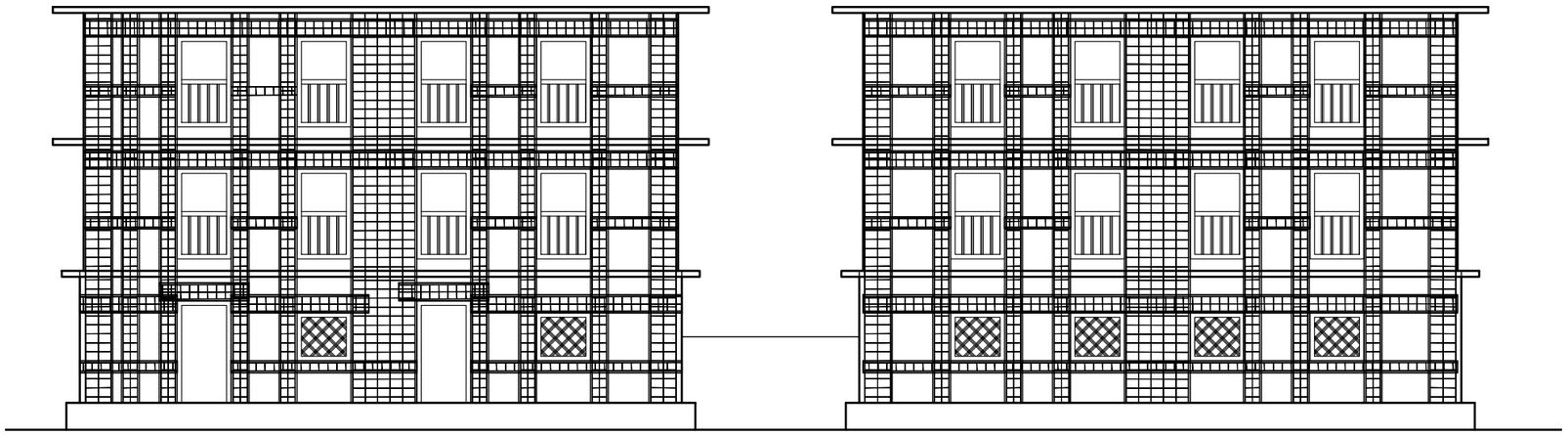
SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- AS SHOWN FOR A3 PAPER

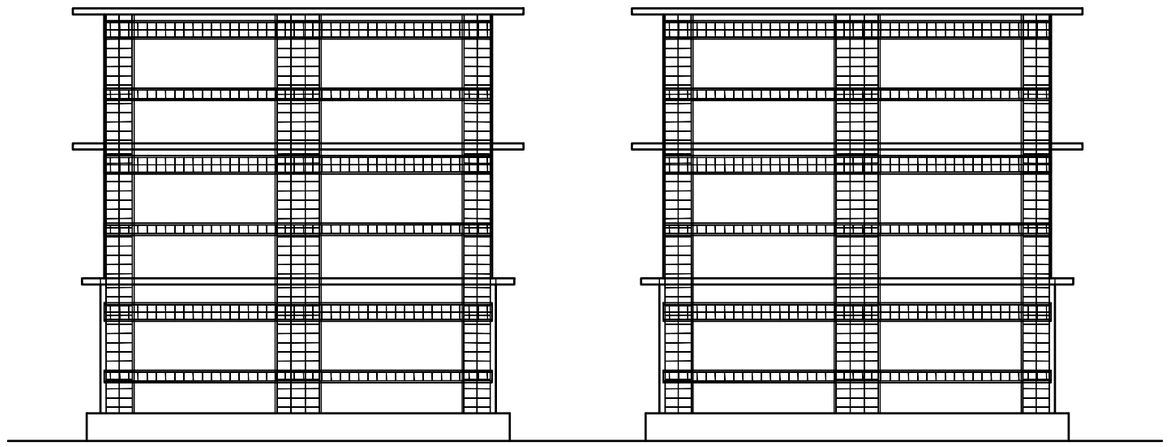
DATE :- JULY, 2017

11



ELEVATION-1

ELEVATION-3



ELEVATION-2

ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF THREE STOREY LOW STRENGTH BRICK MASONRY BUILDING IN CEMENT USING RC BARS

SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING AFTER RETROFIT

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

12

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN ON TWO STOREY BRICK MASONRY BUILDING IN MUD USING RC BARS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

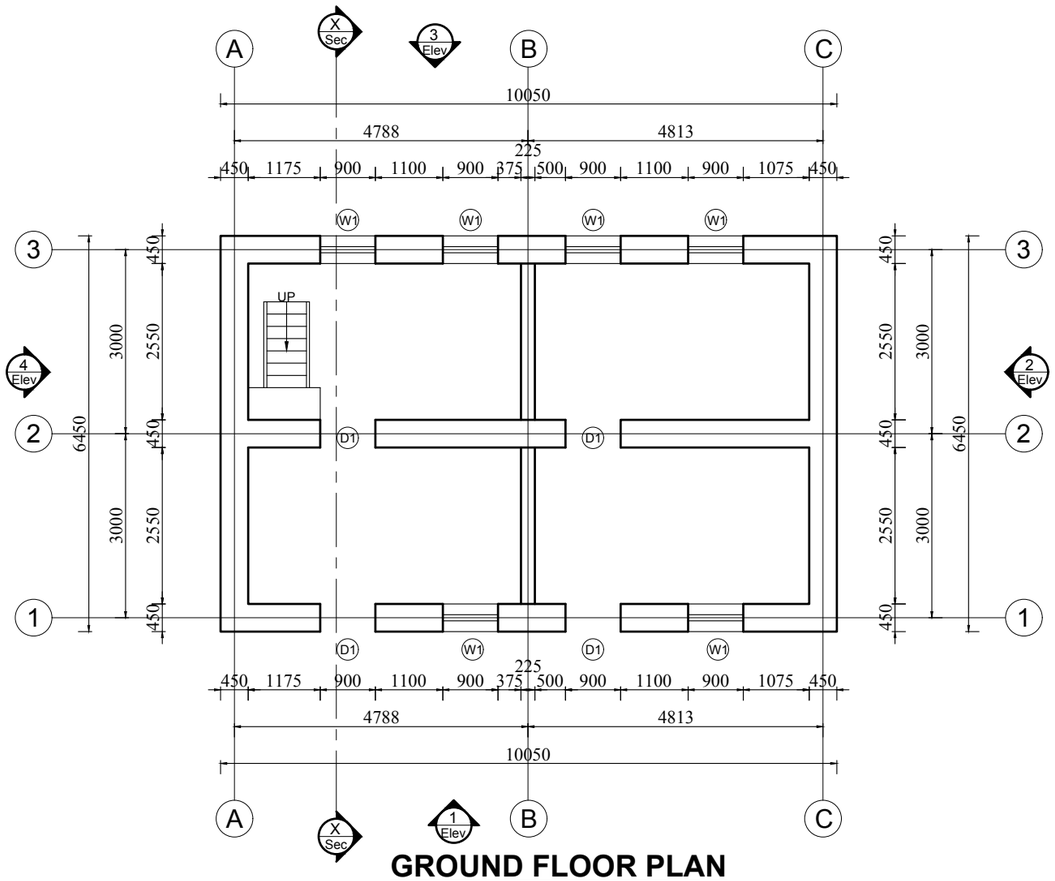
SHEET TITLE :-

COVER PAGE

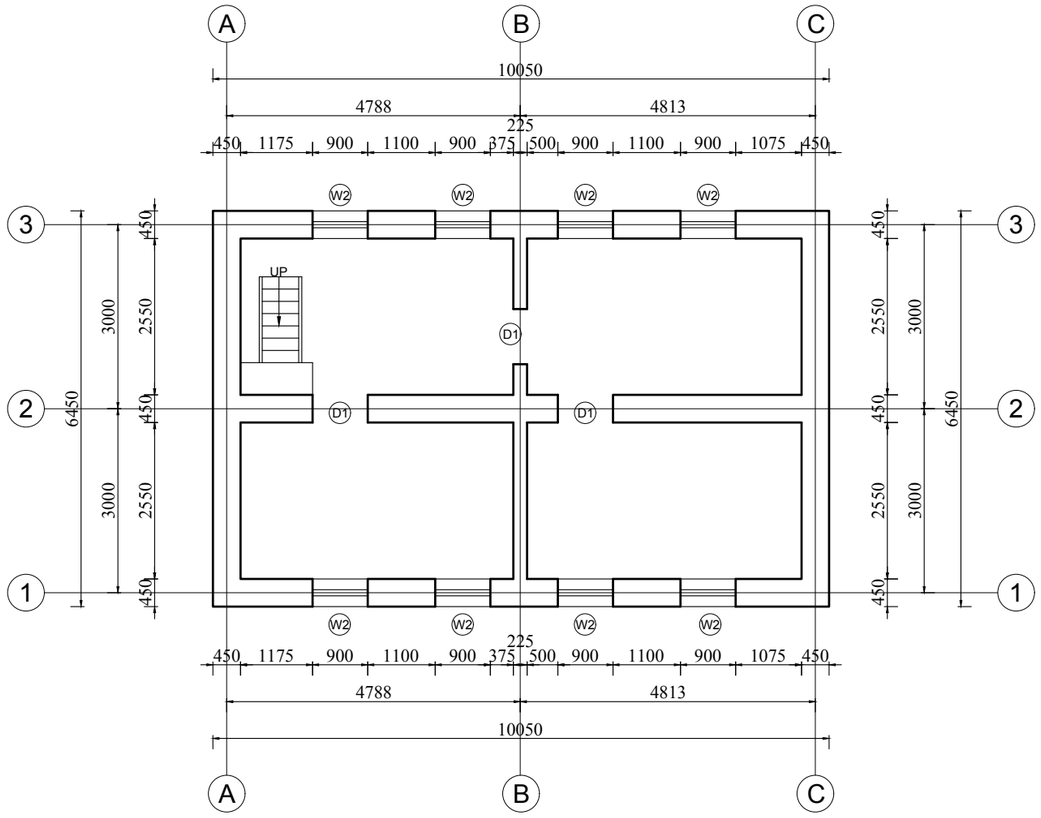
SCALE :- N/A

DATE :- JULY, 2017

0



GROUND FLOOR PLAN



FIRST FLOOR PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

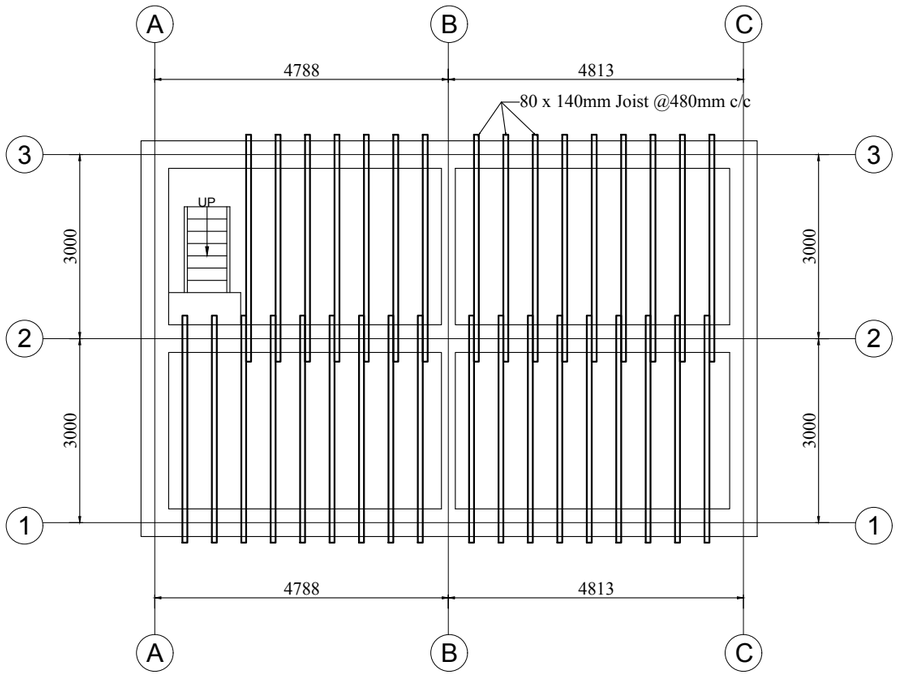
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

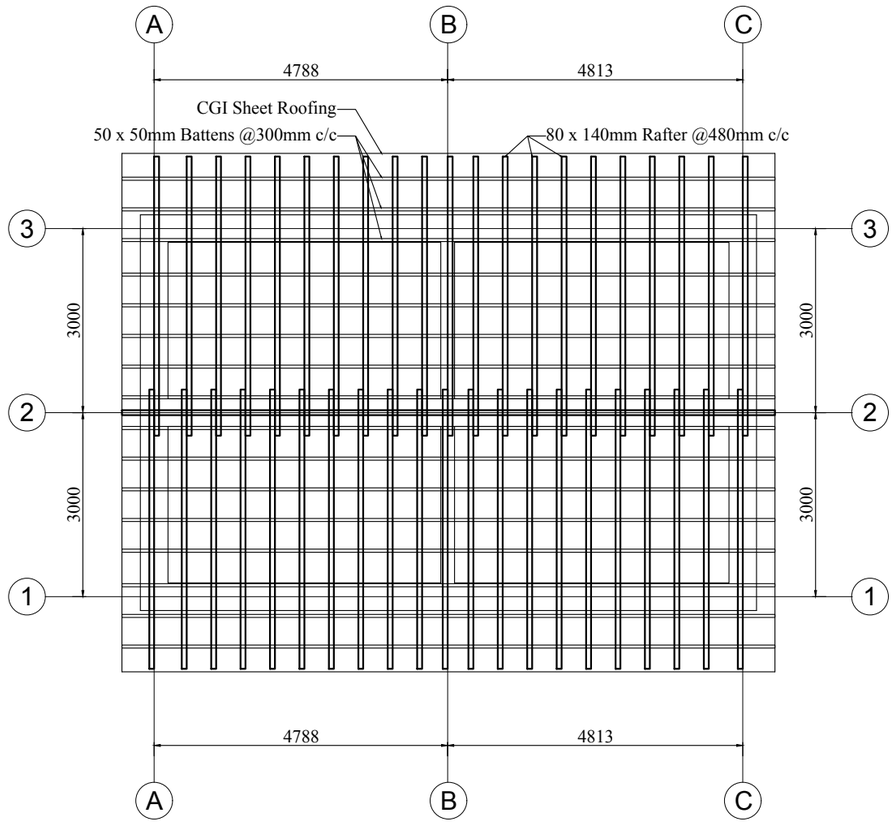
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

01



FLOOR PLAN SHOWING LAYOUT OF JOIST



ROOF PLAN SHOWING LAYOUT OF RAFTER

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

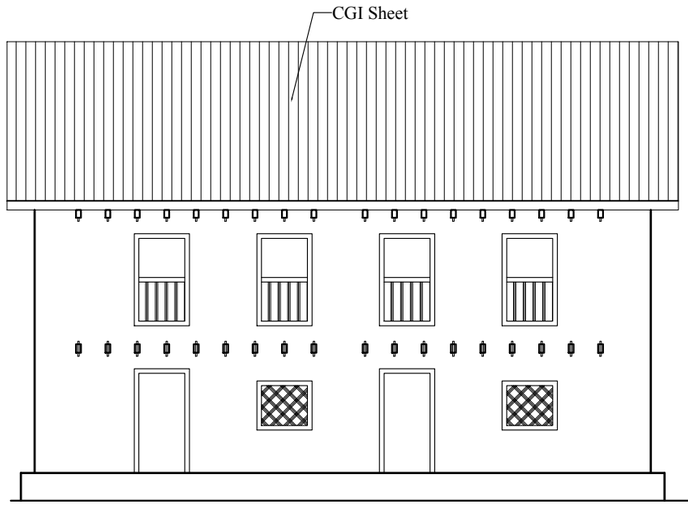
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

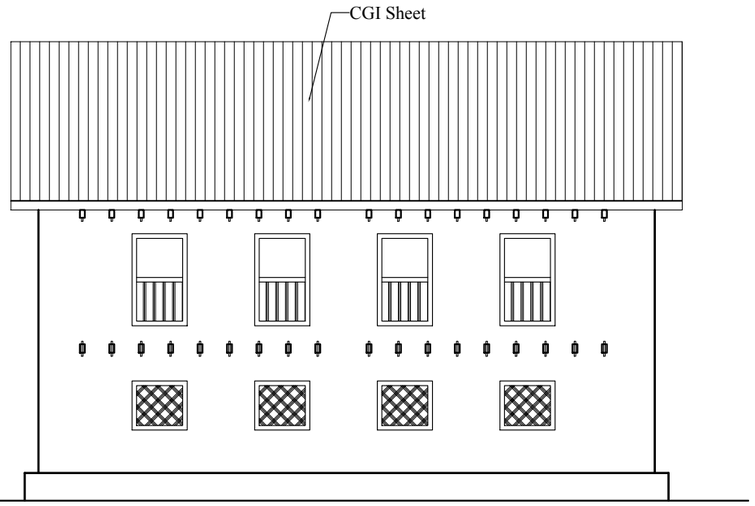
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

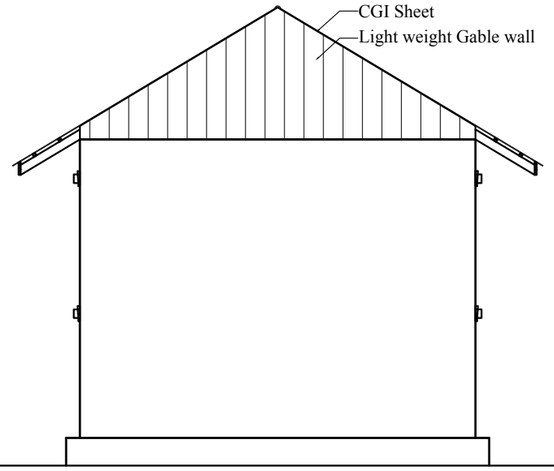
02



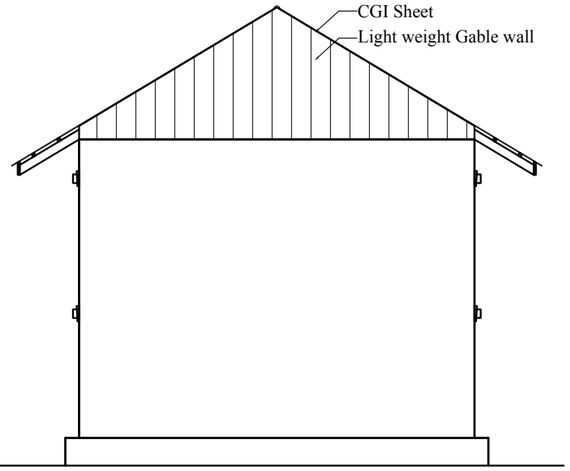
ELEVATION-1



ELEVATION-3



ELEVATION-2



ELEVATION-4

OPENING SCHEDULE

S.N.	SYMBOL	NOS.	SIZE	SILL HEIGHT
1.	DOOR-D	7	900 x 1700	---
2.	WINDOW-W1	6	900 x 800	700
3.	WINDOW-W2	12	900 x 1500	200

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

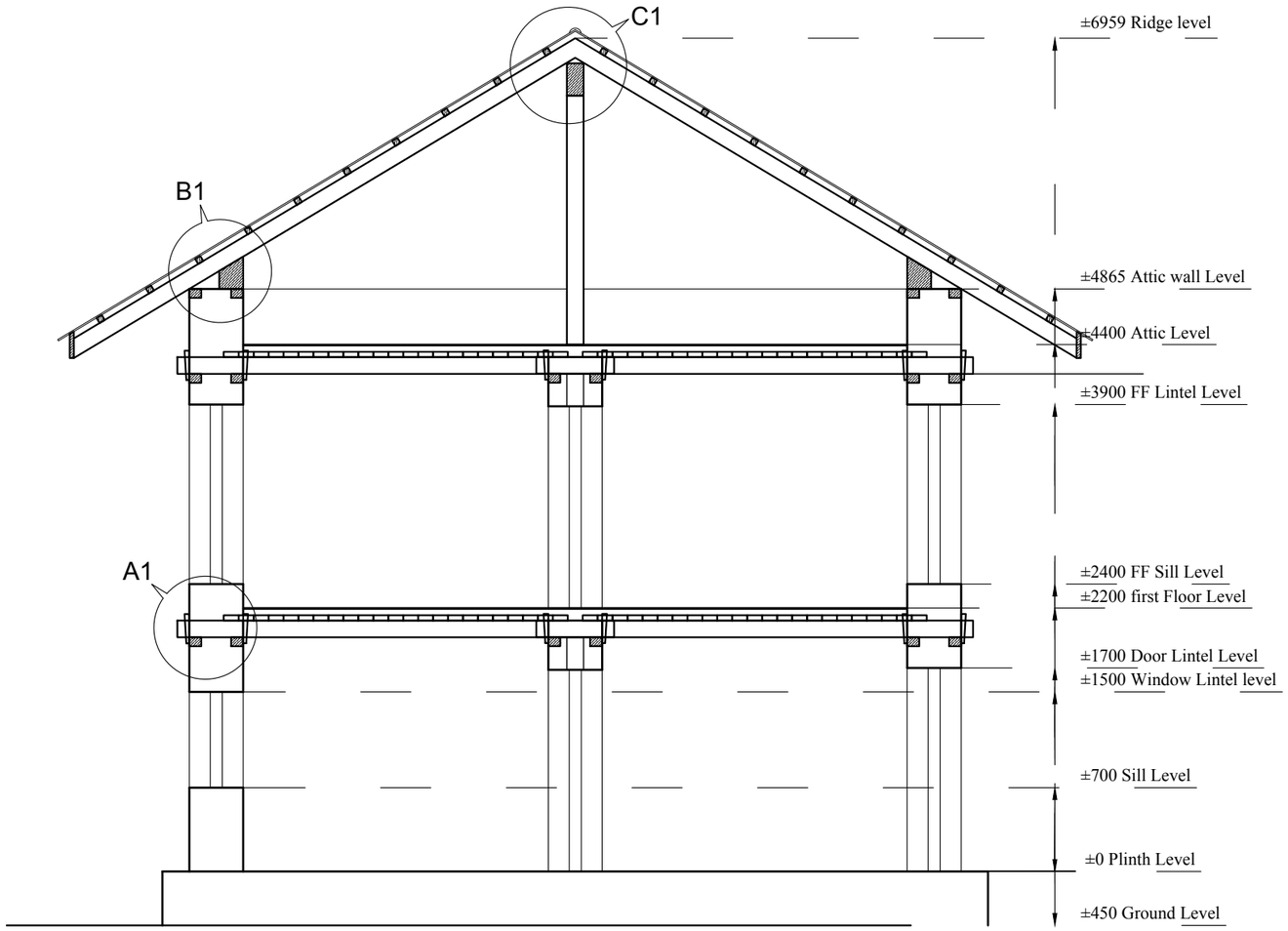
SHEET TITLE :-

ELEVATIONS AND OPENING SCHEDULE OF EXISTING BUILDING

SCALE :- 1:100 FOR A3 PAPER

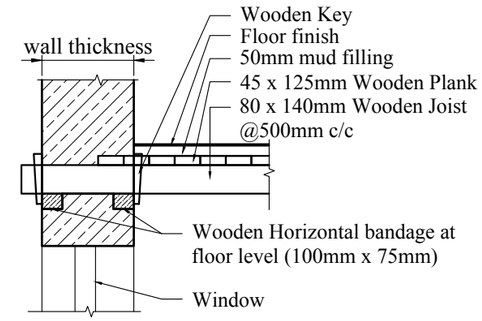
DATE :- JULY, 2017

03



SECTION AT X-X

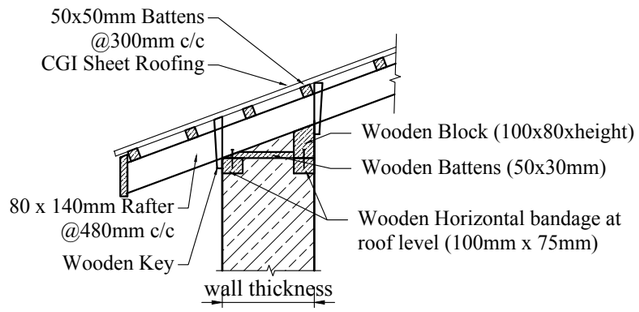
SCALE 1:50



DETAIL A1

SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL

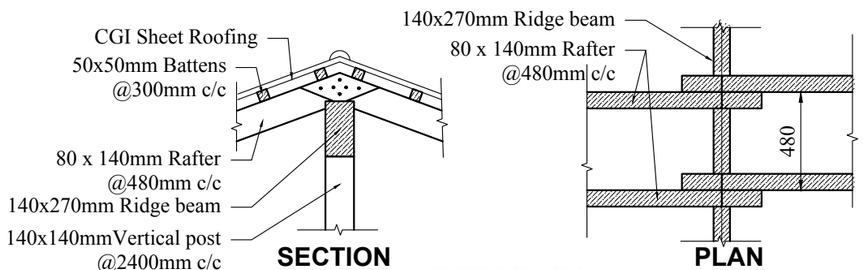
SCALE = 1:30



DETAIL B1

SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL

SCALE = 1:30



SECTION

PLAN

DETAIL C1

SHOWING ROOF DETAILS AT RIDGE LEVEL

SCALE = 1:30

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

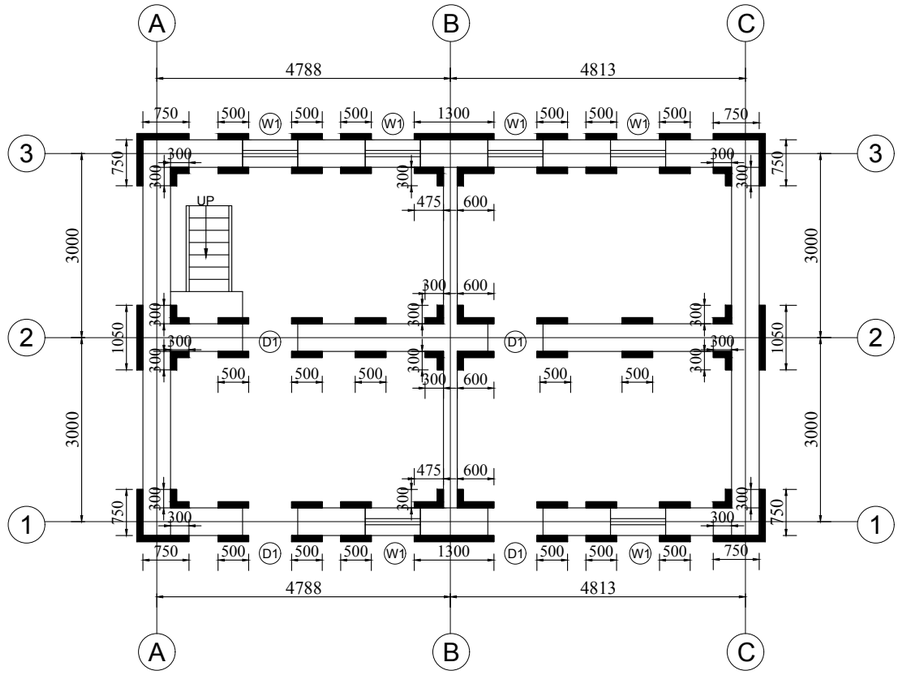
SHEET TITLE :-

SECTION AND DETAILS OF EXISTING BUILDING

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

04

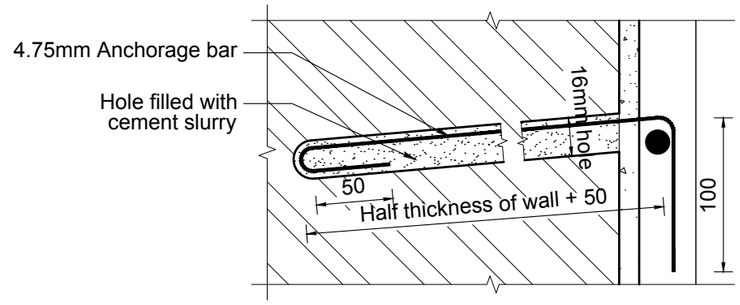


GROUND FLOOR PLAN SHOWING TIE BEAM FOR SPLINT ON WALLS

SCALE = 1:100

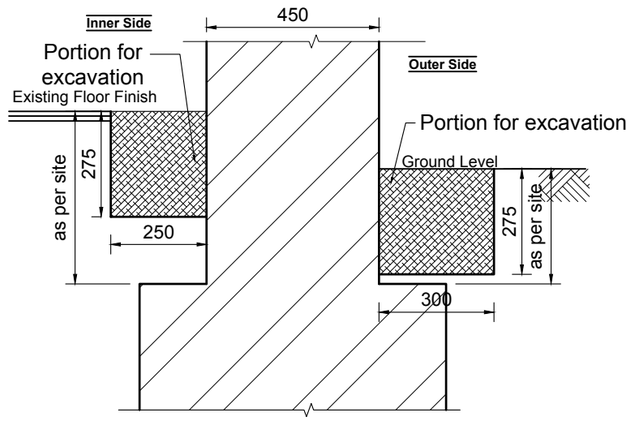
Notes:

Tie beam for Splint on walls using RC Bars of 10mmØ



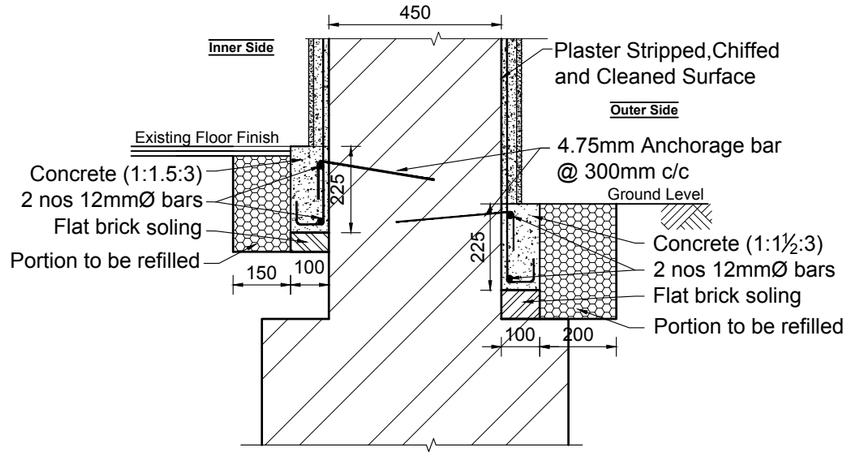
4.75 MM ANCHORAGE BAR DETAILS

SCALE 1:4



SECTION SHOWING THE PORTION TO BE EXCAVATED FOR TIE BEAM

SCALE = 1:16



DETAILS OF TIE BEAM (FOR RC BARS) FOR INNER AND OUTER SIDE OF THE WALL

SCALE = 1:16

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

SHEET TITLE :-

TIE BEAM AND DETAILS

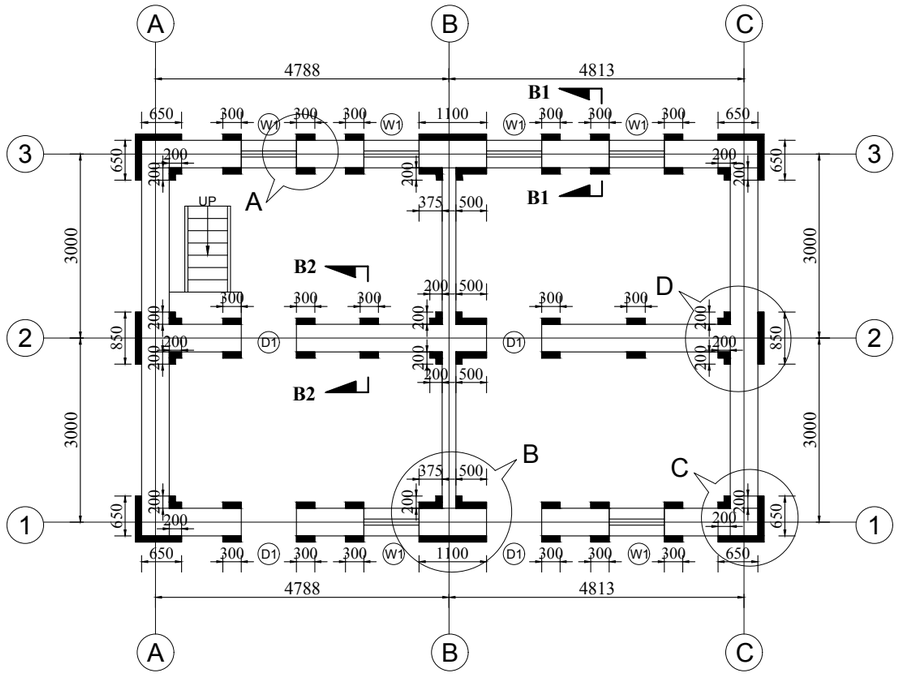
SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

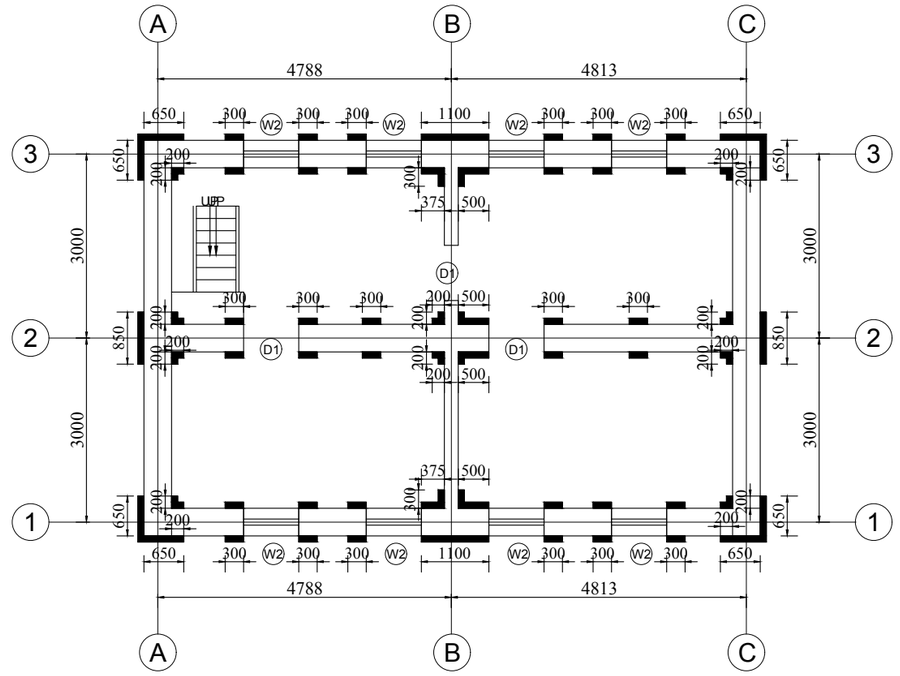
05

Splint

- 200mm width on each sides of corners and junctions using 3-10mmØ bars
- 300mm width for sides of openings and on walls using 3-10mmØ bars



GROUND FLOOR PLAN SHOWING LOCATION OF SPLINT ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF SPLINT ON WALLS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

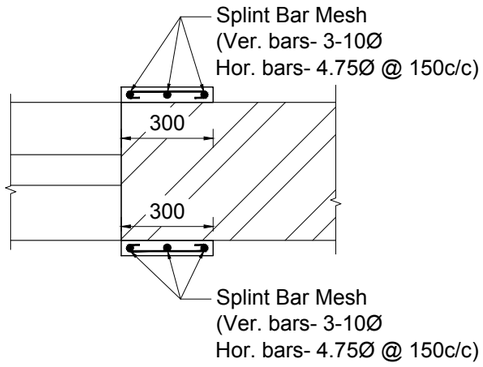
SHEET TITLE :-

FLOOR PLANS SHOWING LOCATION OF SPLINT ON WALLS

06

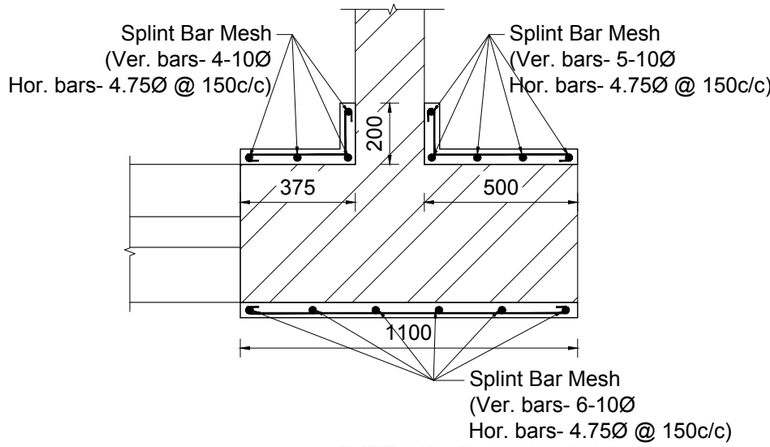
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017



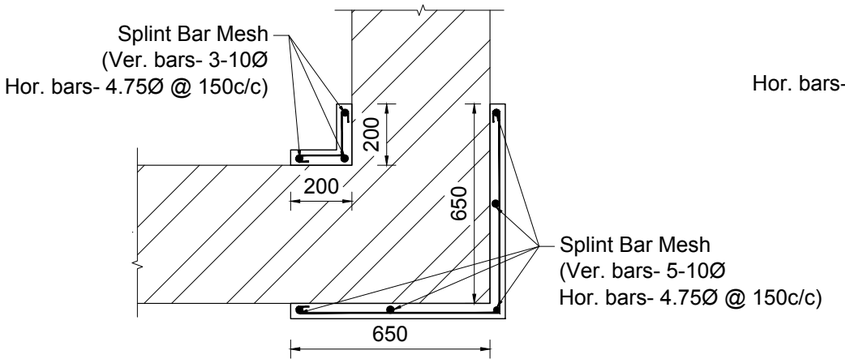
DETAIL-A SHOWING
VERTICAL SPLINT AT SIDES OF OPENING

SCALE = 1:20



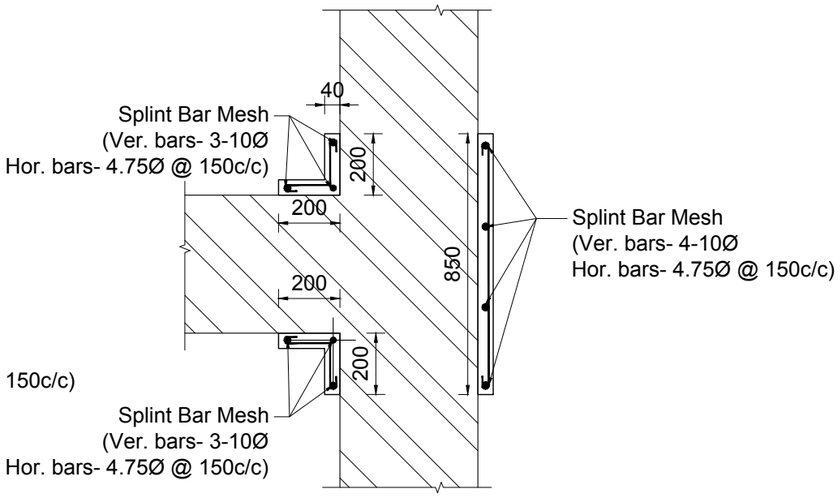
DETAIL-B SHOWING
VERTICAL SPLINT AT JUNCTION

SCALE = 1:20



DETAIL-C SHOWING
VERTICAL SPLINT AT CORNER

SCALE = 1:20



DETAIL-D SHOWING
VERTICAL SPLINT AT JUNCTION

SCALE = 1:20

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

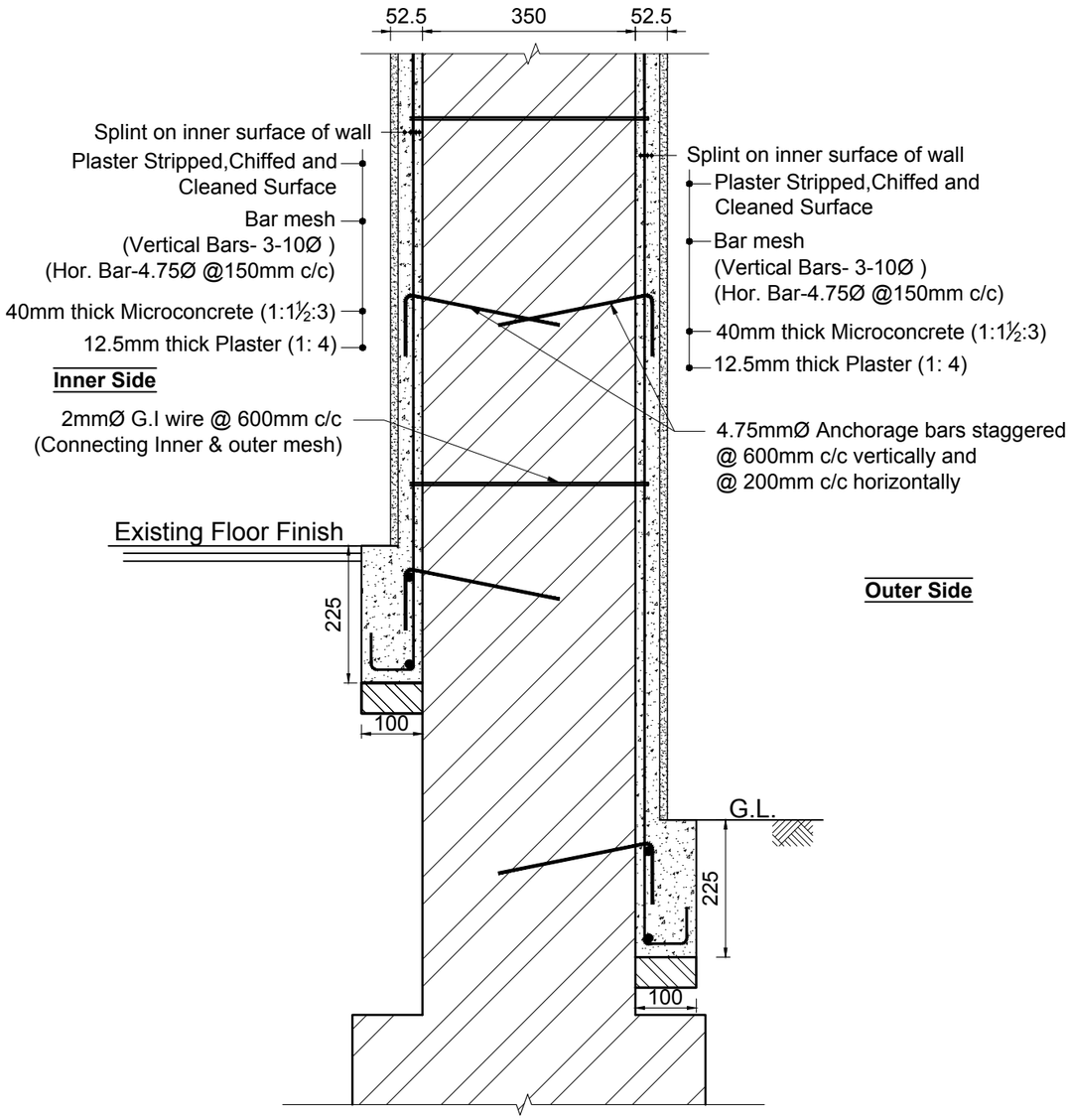
SHEET TITLE :-

DETAILS OF SPLINT

SCALE :- 1:20 FOR A3 PAPER

DATE :- JULY, 2017

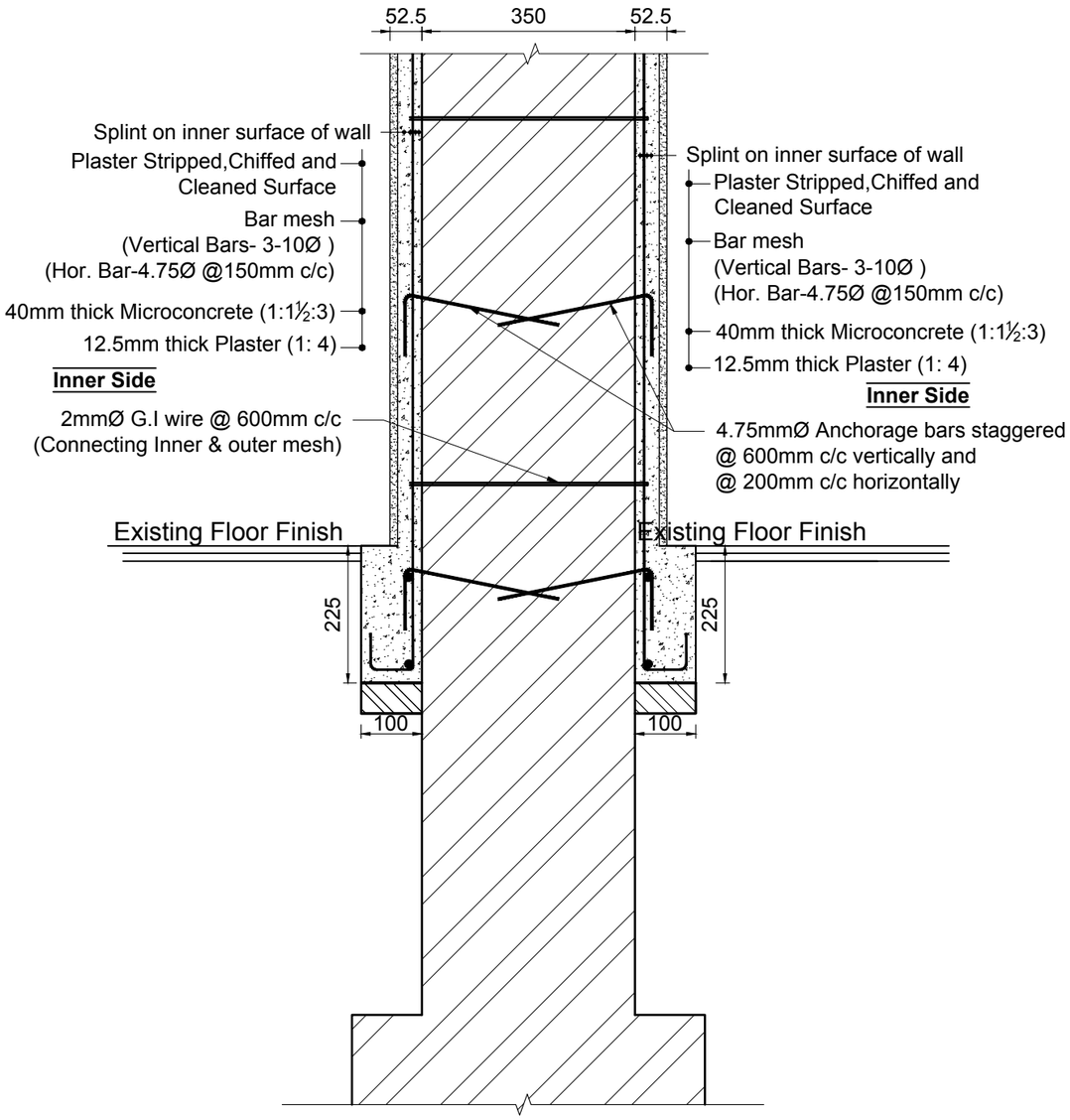
07



SECTION AT B1-B1

(DETAILS OF SPLINT ON BOTH SURFACES OF INTERNAL WALLS)

SCALE = 1:10



SECTION AT B2-B2

(DETAILS OF SPLINT ON BOTH SURFACES OF INTERNAL WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

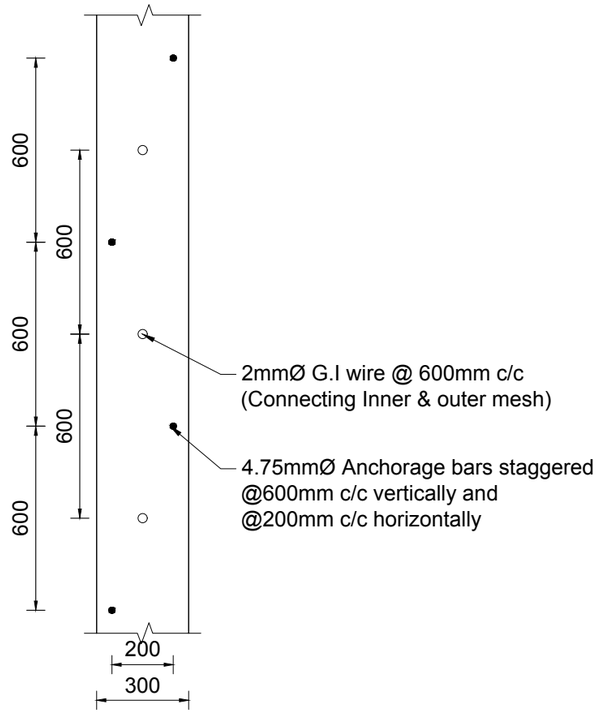
SHEET TITLE :-

DETAILS OF SPLINT

SCALE :- 1:10 FOR A3 PAPER

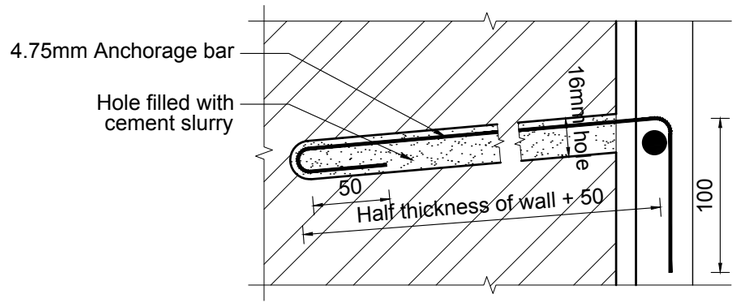
DATE :- JULY, 2017

08



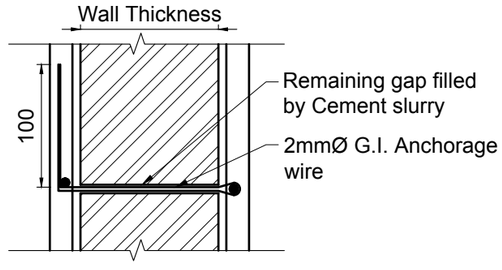
LAYOUT OF ANCHORAGE BARS FOR CONNECTING SPLINT BANDS ON BOTH SIDES OF WALLS

SCALE 1:20



ANCHORAGE BAR DETAILS

SCALE 1:4



G.I. WIRE DETAILS

SCALE 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

SHEET TITLE :-

DETAILS OF SPLINT

SCALE :- 1:20, 1:10, 1:4 FOR A3 PAPER

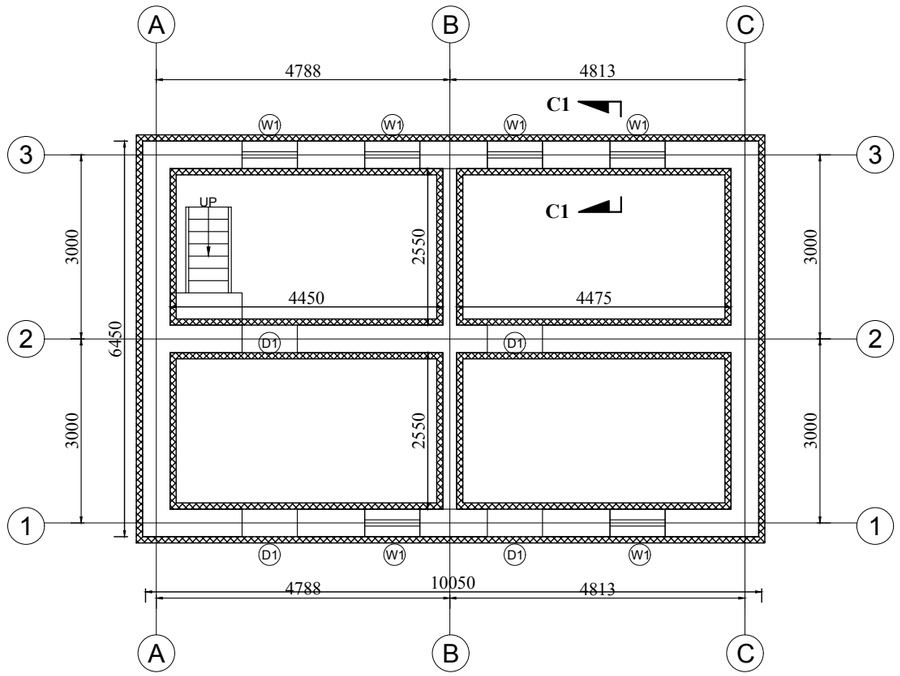
DATE :- JULY, 2017

09

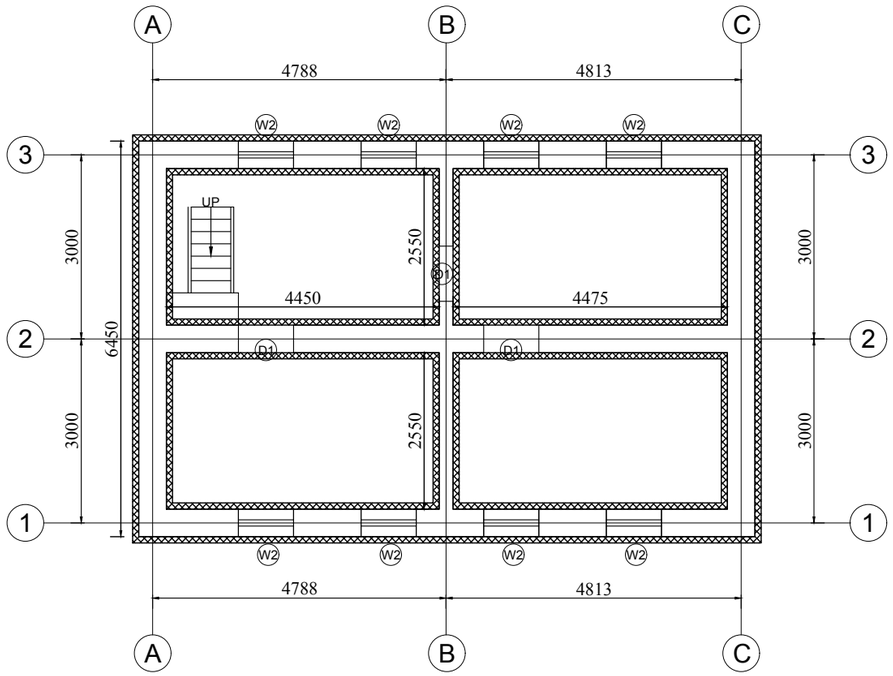
Notes:

Horizontal Bands

- 200mm width using 2-4.75mmØ bars at sill and mid level
- 300mm width using 2-4.75mmØ + 1-8mmØ bars at lintel level



GROUND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS

PROJECT TITLE :-

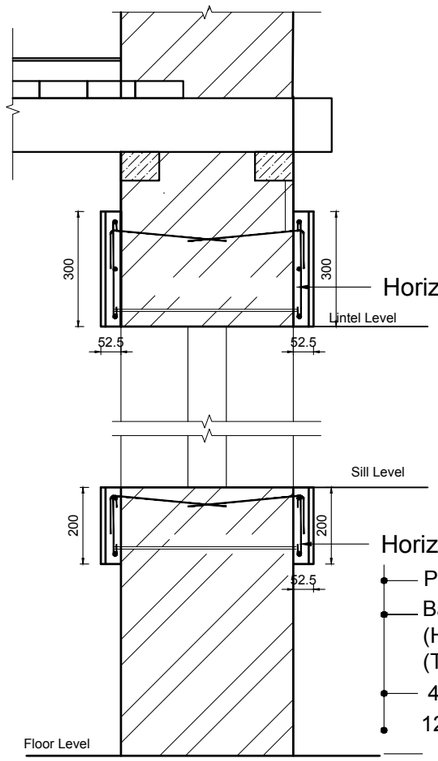
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

SHEET TITLE :- FLOOR PLANS SHOWINGLOCATIONS OF HORIZONTAL BANDAGES AT FLOOR AND SILL LEVEL

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

10



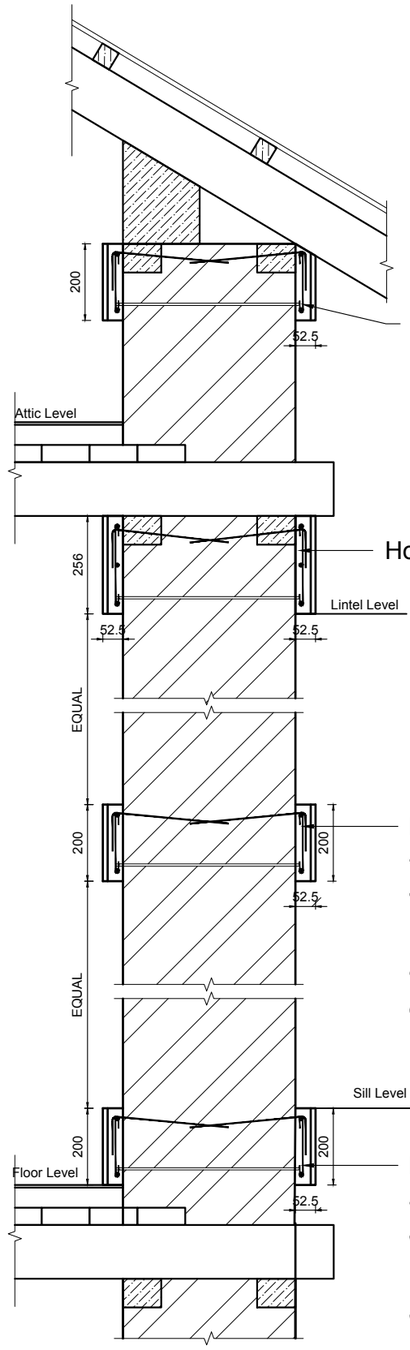
Horizontal Lintel bands on walls
- Plaster Stripped,Chiffed and Cleaned Surface
- Bar Mesh
  (Hor. Bars= 2-4.75Ø + 1-8Ø)
  (Tie Bars= 4.75Ø @ 150c/c)
- 40mm thick Microconcrete (1:1½:3)
- 12.5mm thick Plaster (1: 4)

Horizontal Sill bands on walls
- Plaster Stripped,Chiffed and Cleaned Surface
- Bar Mesh
  (Hor. Bars= 2-4.75Ø)
  (Tie Bars= 4.75Ø @ 150c/c)
- 40mm thick Microconcrete (1:1½:3)
- 12.5mm thick Plaster (1: 4)

SECTION AT C1-C1

(DETAILS OF HORIZONTAL BANDAGES ON BOTH SURFACES OF WALLS)

SCALE = 1:16



Horizontal eaves bands on walls
- Plaster Stripped,Chiffed and Cleaned Surface
- Bar Mesh
  (Hor. Bars= 2-4.75Ø)
  (Tie Bars= 4.75Ø @ 150c/c)
- 40mm thick Microconcrete (1:1½:3)
- 12.5mm thick Plaster (1: 4)

Horizontal Lintel bands on walls
- Plaster Stripped,Chiffed and Cleaned Surface
- Bar Mesh
  (Hor. Bars= 2-4.75Ø + 1-8Ø)
  (Tie Bars= 4.75Ø @ 150c/c)
- 40mm thick Microconcrete (1:1½:3)
- 12.5mm thick Plaster (1: 4)

Horizontal bands on walls
- Plaster Stripped,Chiffed and Cleaned Surface
- Bar Mesh
  (Hor. Bars= 2-4.75Ø)
  (Tie Bars= 4.75Ø @ 150c/c)
- 40mm thick Microconcrete (1:1½:3)
- 12.5mm thick Plaster (1: 4)

Horizontal Sill bands on walls
- Plaster Stripped,Chiffed and Cleaned Surface
- Bar Mesh
  (Hor. Bars= 2-4.75Ø)
  (Tie Bars= 4.75Ø @ 150c/c)
- 40mm thick Microconcrete (1:1½:3)
- 12.5mm thick Plaster (1: 4)

SECTION AT C2-C2

(DETAILS OF HORIZONTAL BANDAGES ON BOTH SURFACES OF WALLS)

SCALE = 1:16

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

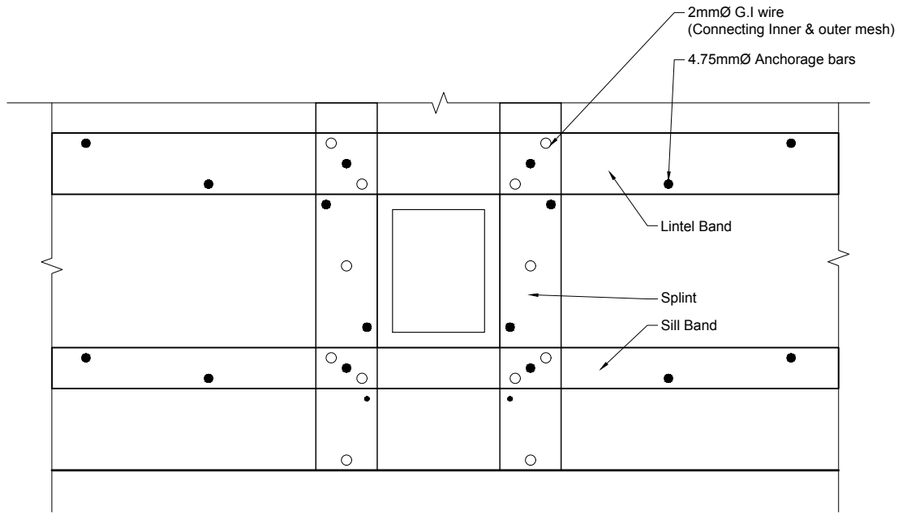
SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- 1:16 FOR A3 PAPER

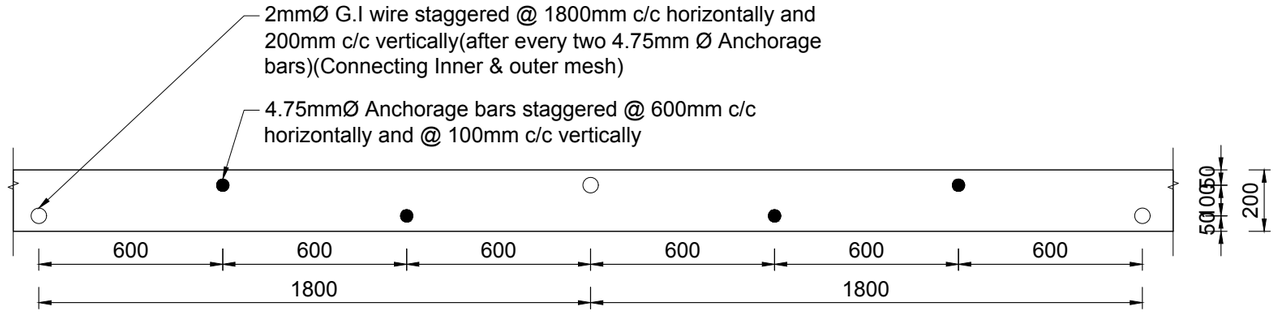
DATE :- JULY, 2017

11



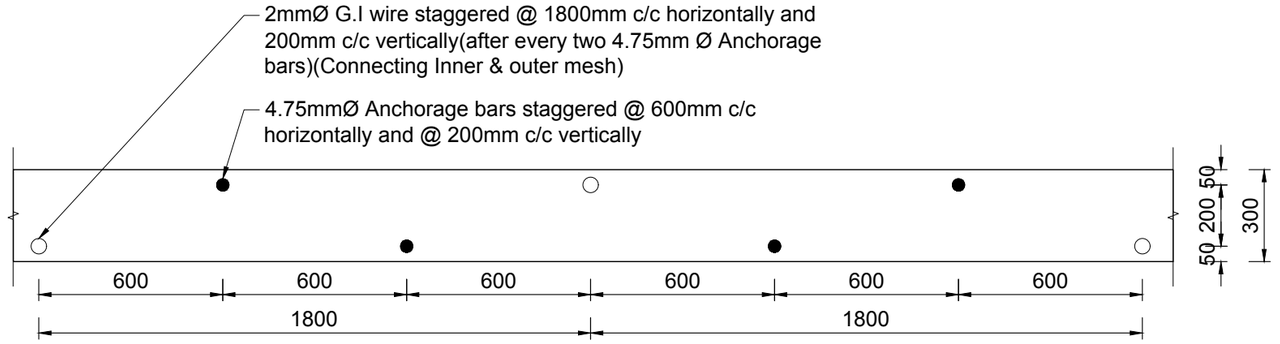
TYPICAL LAYOUT OF ANCHORAGE FOR CONNECTING SPLINT AND HORIZONTAL BANDAGE ON BOTH SIDES OF WALLS

SCALE 1:30



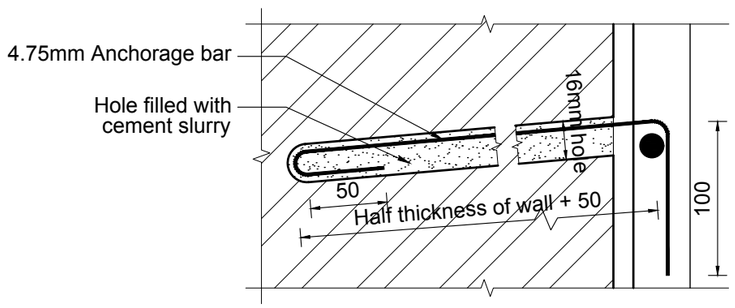
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT SILL AND MID LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



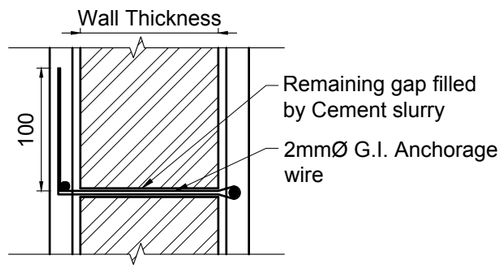
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT LINTEL LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



ANCHORAGE BAR DETAILS

SCALE 1:4



G.I. WIRE DETAILS

SCALE 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH BRICK MASONRY BUILDING IN MUD USING RC BARS

SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

12

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN ON TWO STOREY STONE MASONRY BUILDING IN MUD USING RC BARS AND G.I. WIREMESH

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

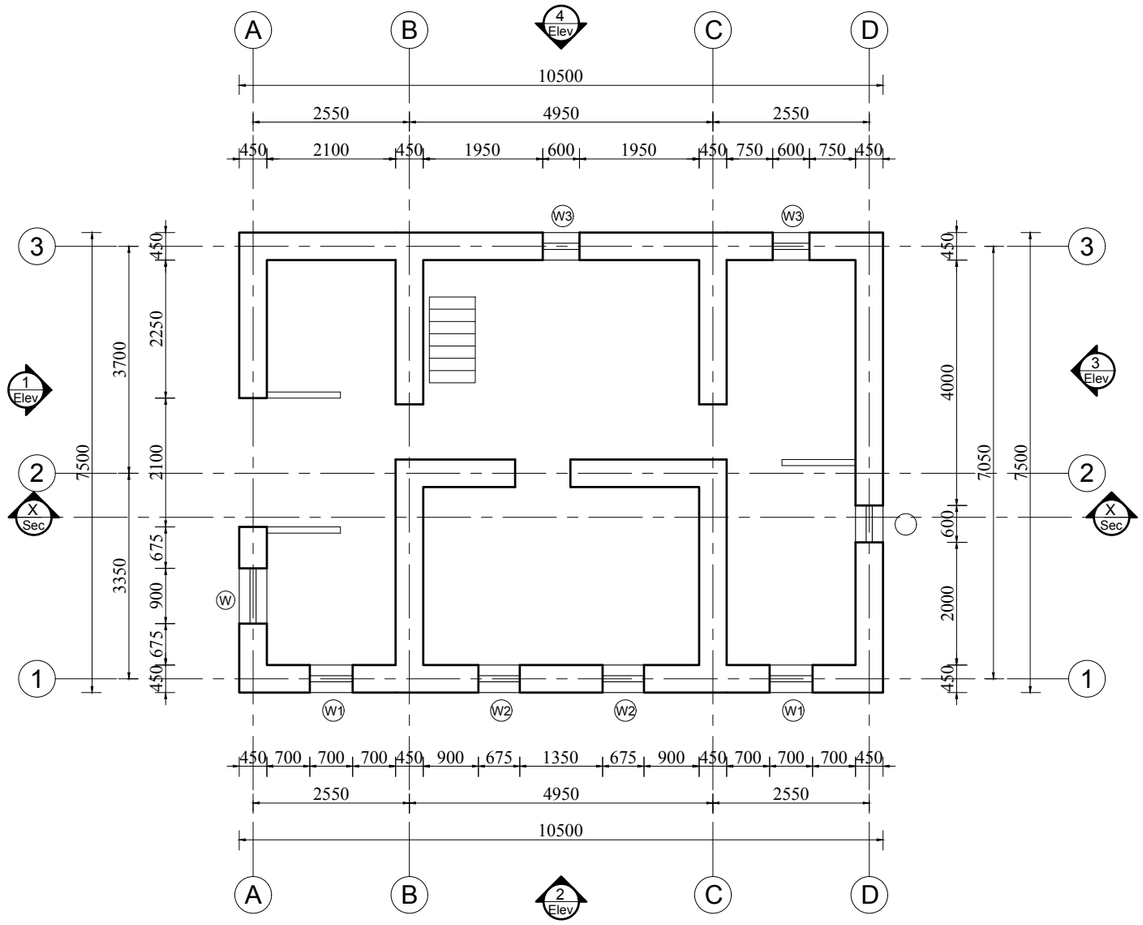
SHEET TITLE :-

COVER PAGE

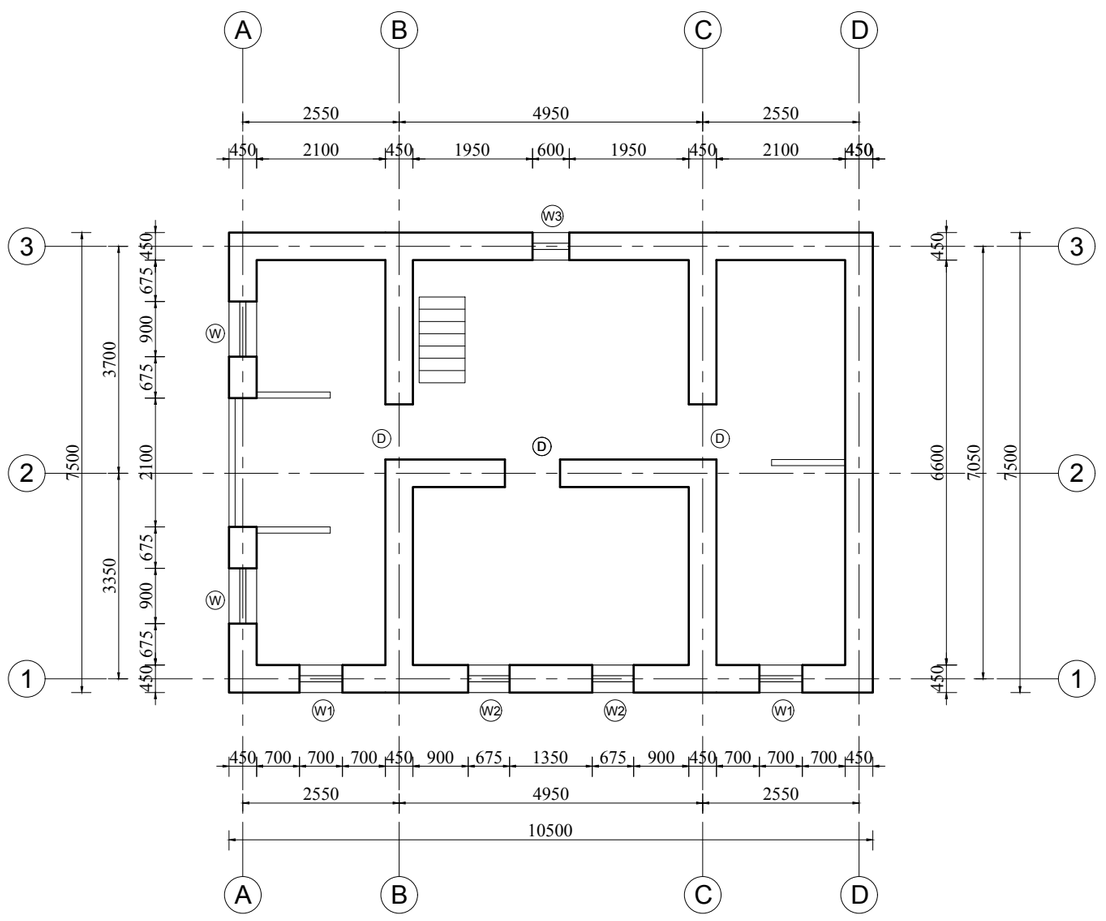
0

SCALE :- N/A

DATE :- JULY, 2017



GROUND FLOOR PLAN



FIRST FLOOR PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

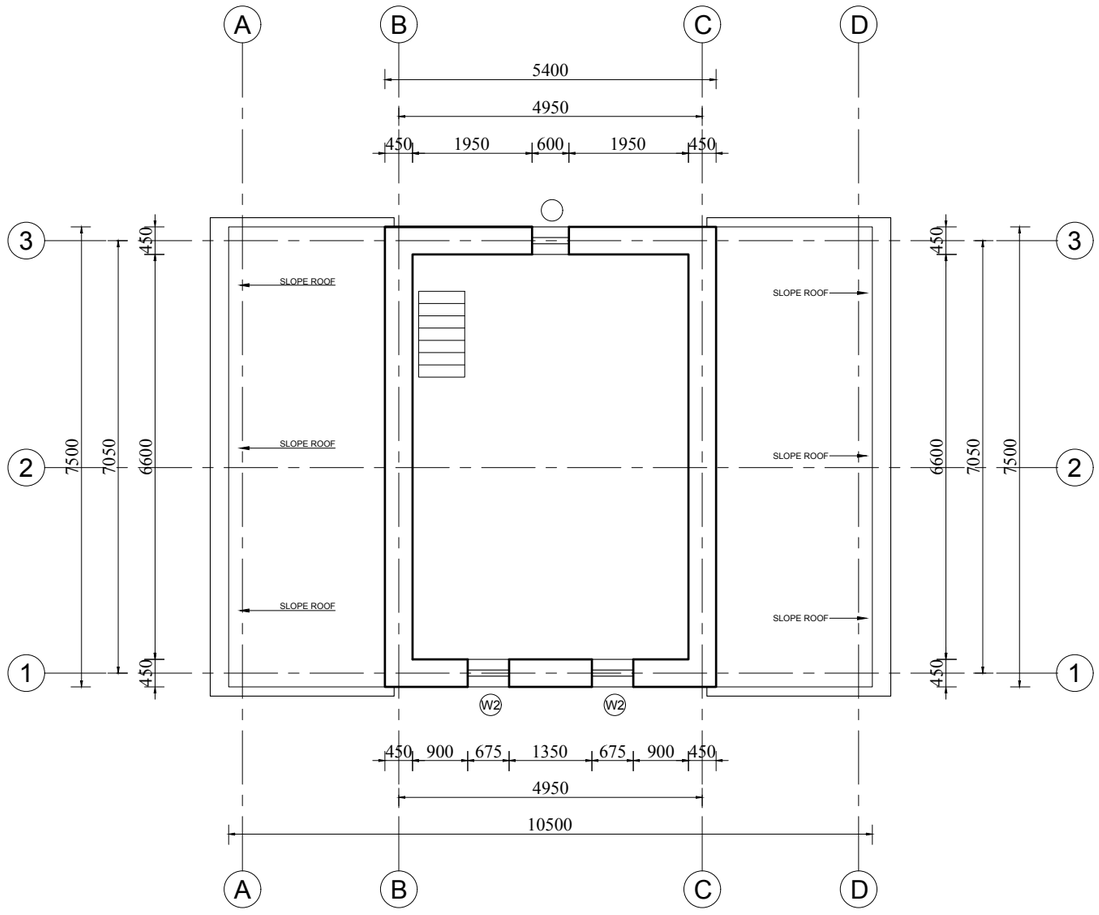
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

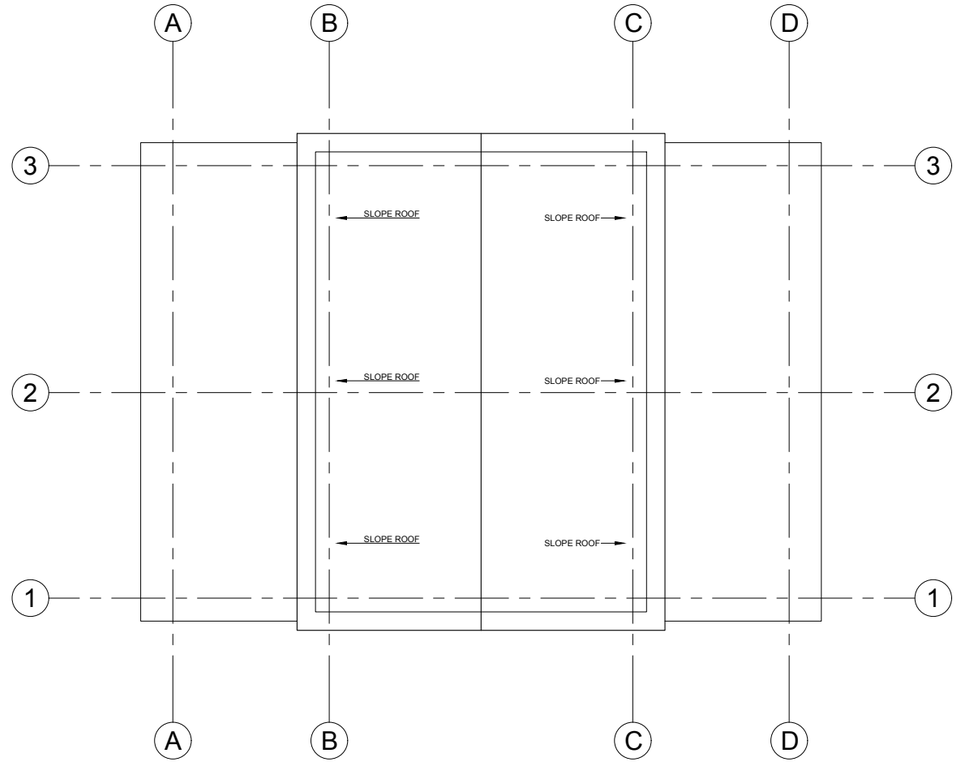
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

01



SECOND FLOOR PLAN



ROOF PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

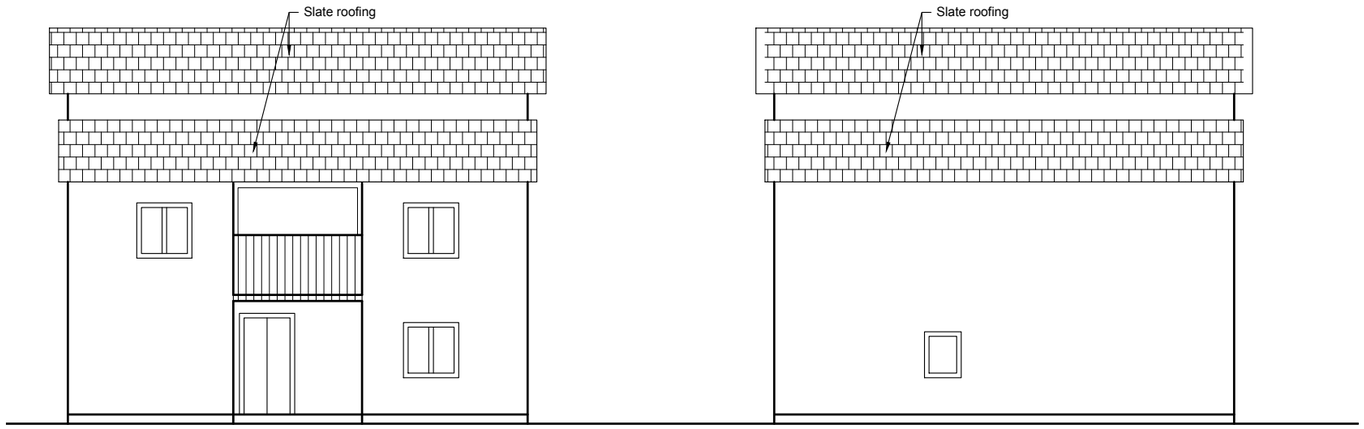
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

SCALE :- 1:100 FOR A3 PAPER

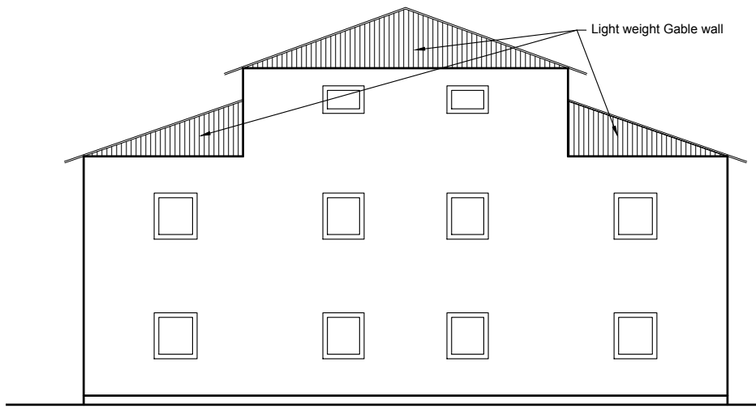
DATE :- JULY, 2017

02

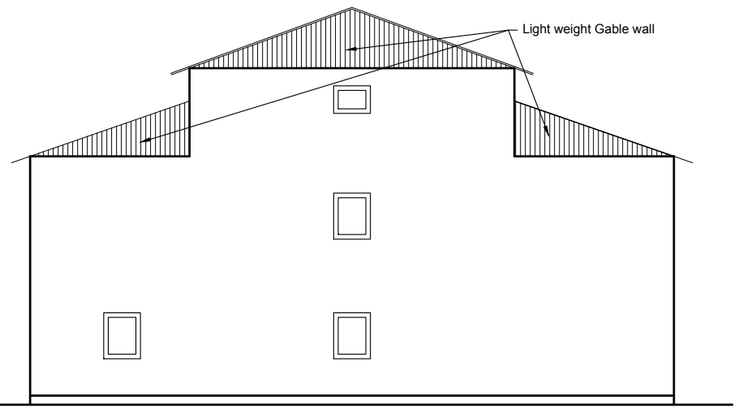


ELEVATION-1

ELEVATION-3



ELEVATION-2



ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

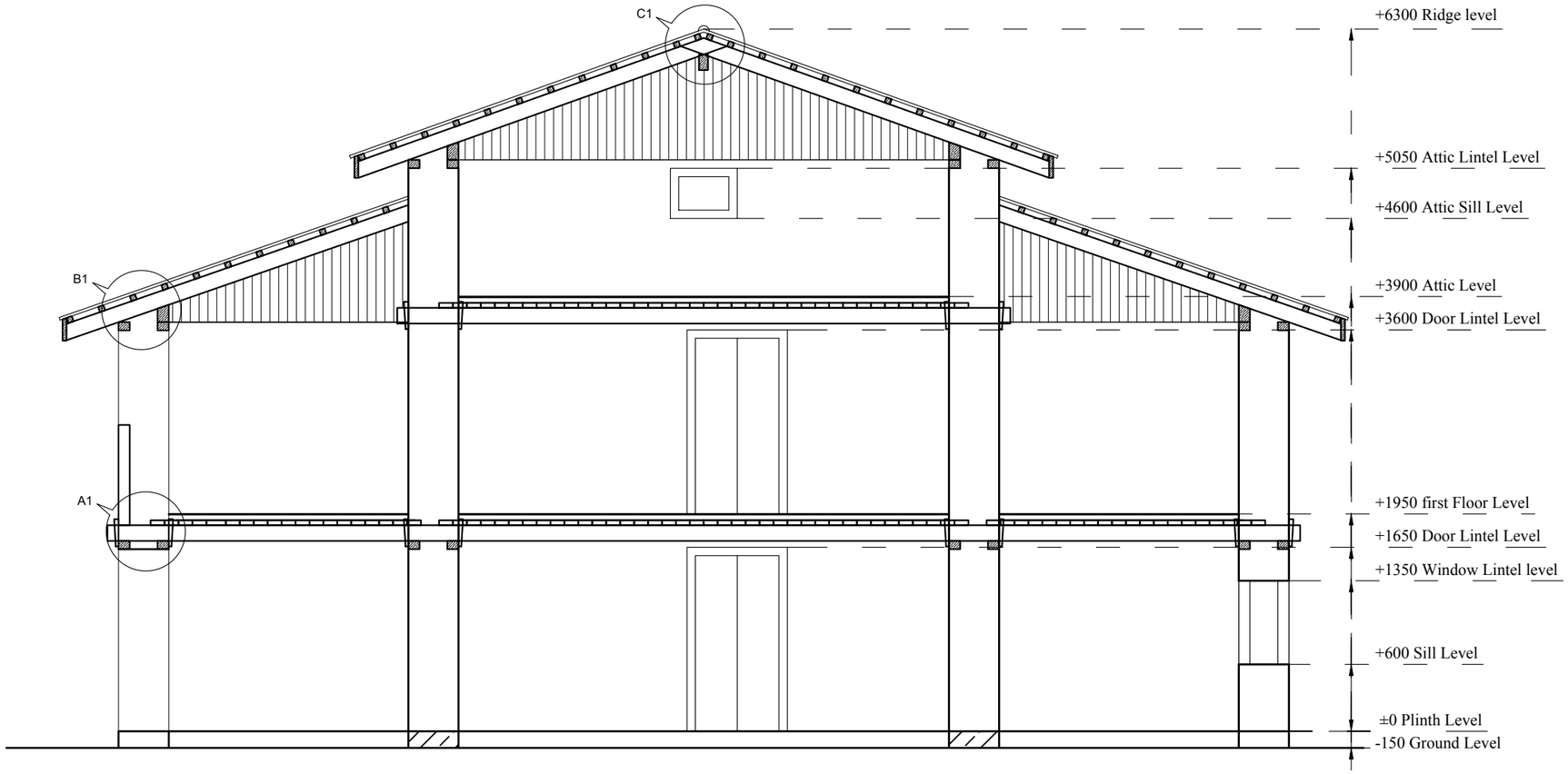
SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING

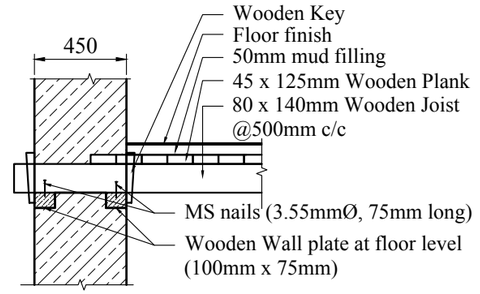
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

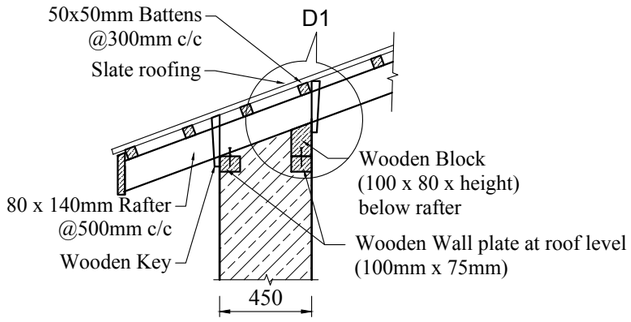
03



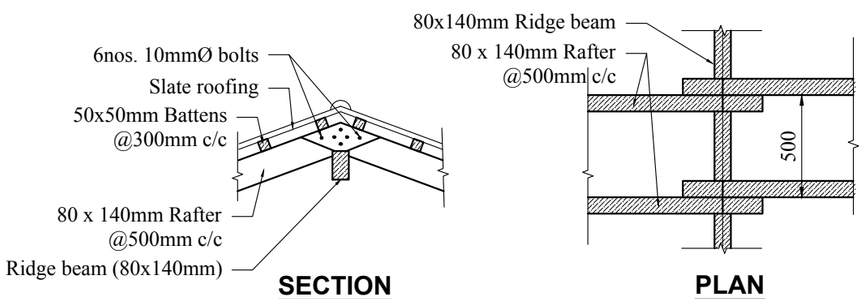
SECTION AT X-X
SCALE = 1:50



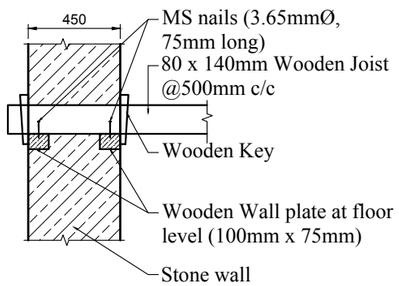
DETAIL A1
SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL
SCALE = 1:30



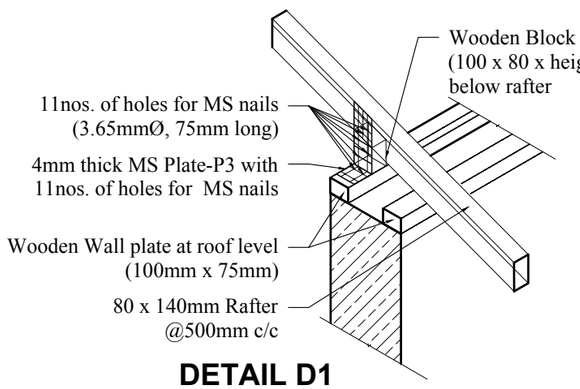
DETAIL B1
SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL
SCALE = 1:30



DETAIL C1
SHOWING ROOF DETAILS AT RIDGE LEVEL
SCALE = 1:30



FIXING OF JOISTS
SCALE = 1:30



DETAIL D1
SHOWING CONNECTION OF RAFTER WITH ROOF BAND
SCALE = 1:30

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

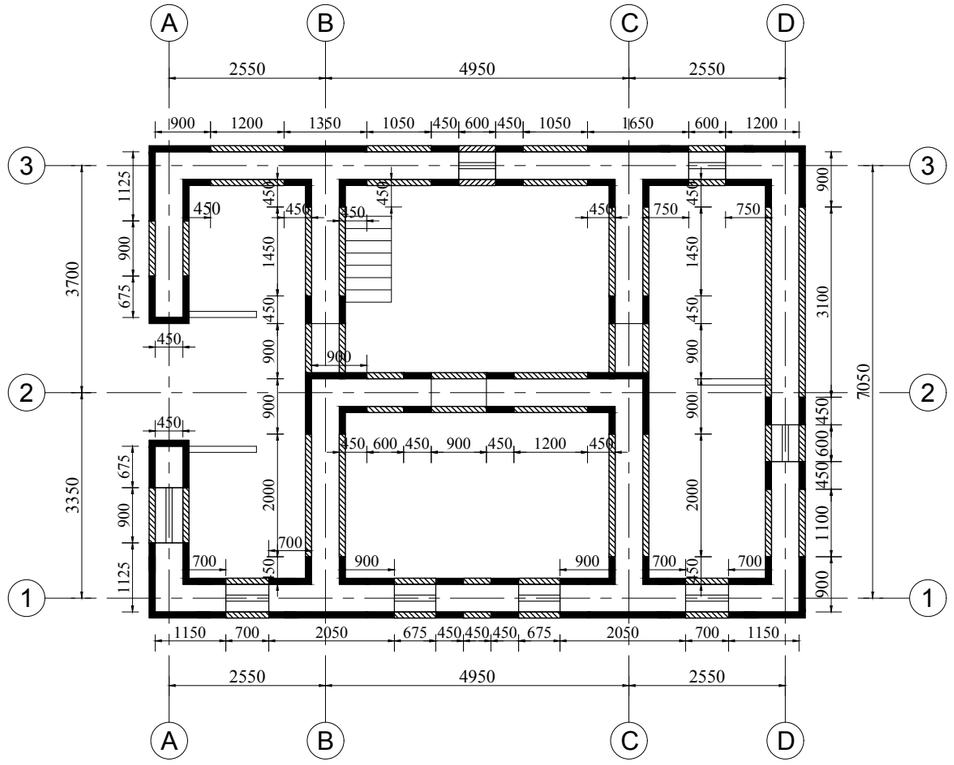
SHEET TITLE :-

SECTION OF EXISTING BUILDING AND DETAILS

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

04

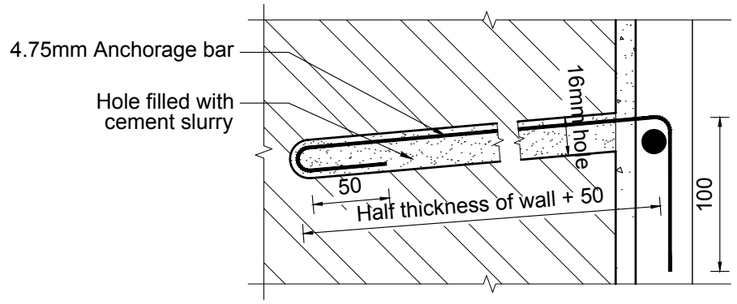


GROUND FLOOR PLAN SHOWING TIE BEAM FOR SPLINT AND JACKETING

SCALE = 1:100

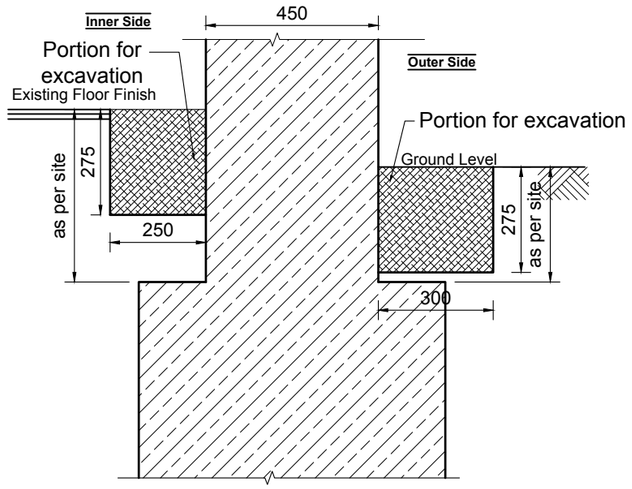
Notes:

- Tie beam for Splint on walls using RC Bars of 8mmØ and/or 4.75mmØ
- Tie beam for Jacketing on remaining walls using G.I. wire of 14SWG (2.03mm Ø) @ 100mm c/c both horizontally and vertically



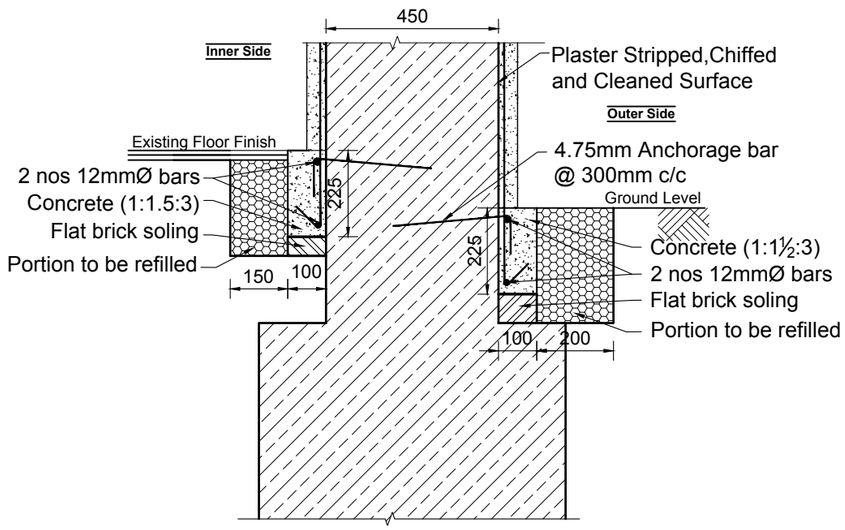
4.75 MM ANCHORAGE BAR DETAILS

SCALE 1:4



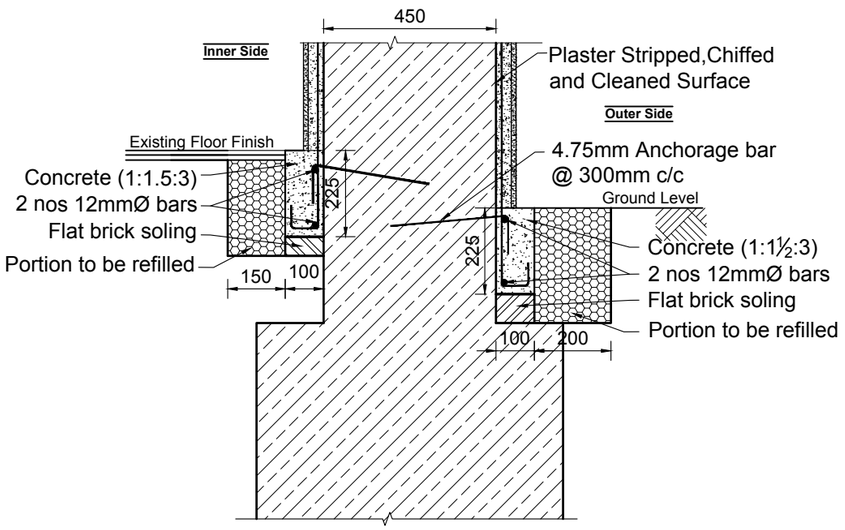
SECTION SHOWING THE PORTION TO BE EXCAVATED FOR TIE BEAM

SCALE = 1:16



DETAILS OF TIE BEAM (FOR G.I. WIREMESH) FOR INNER AND OUTER SIDE OF THE WALL

SCALE = 1:16



DETAILS OF TIE BEAM (FOR RC BARS) FOR INNER AND OUTER SIDE OF THE WALL

SCALE = 1:16

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

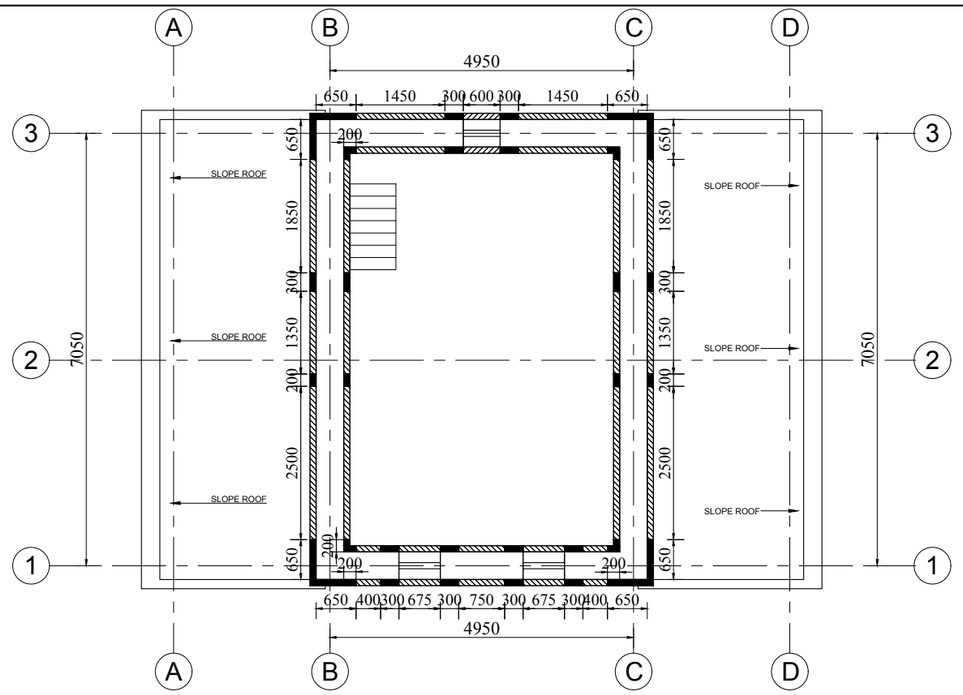
SHEET TITLE :-

TIE BEAM AND DETAILS

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

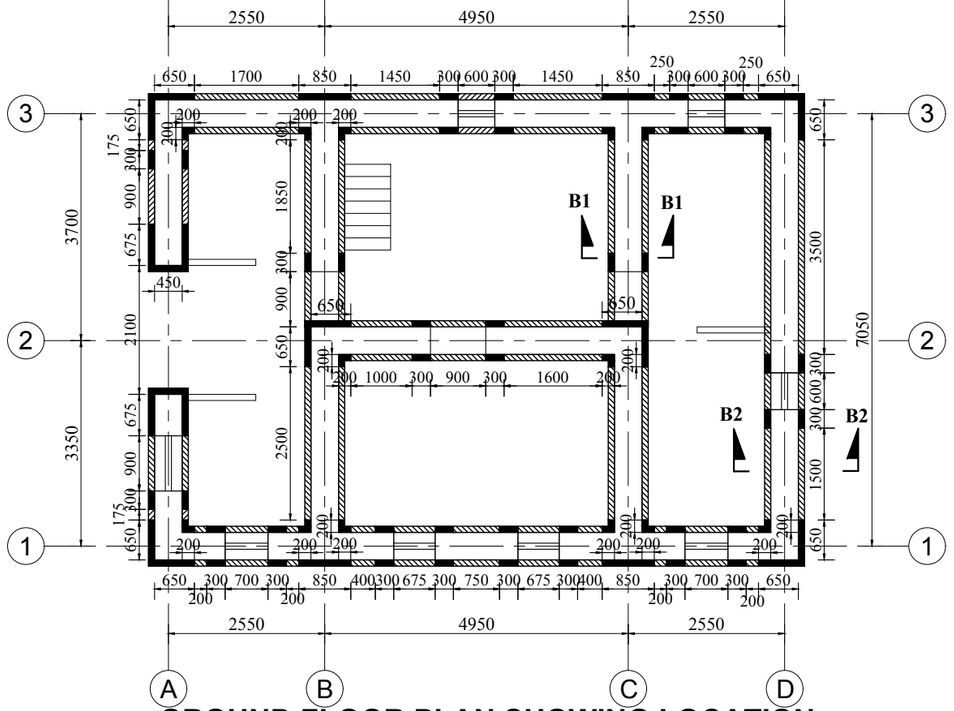
05



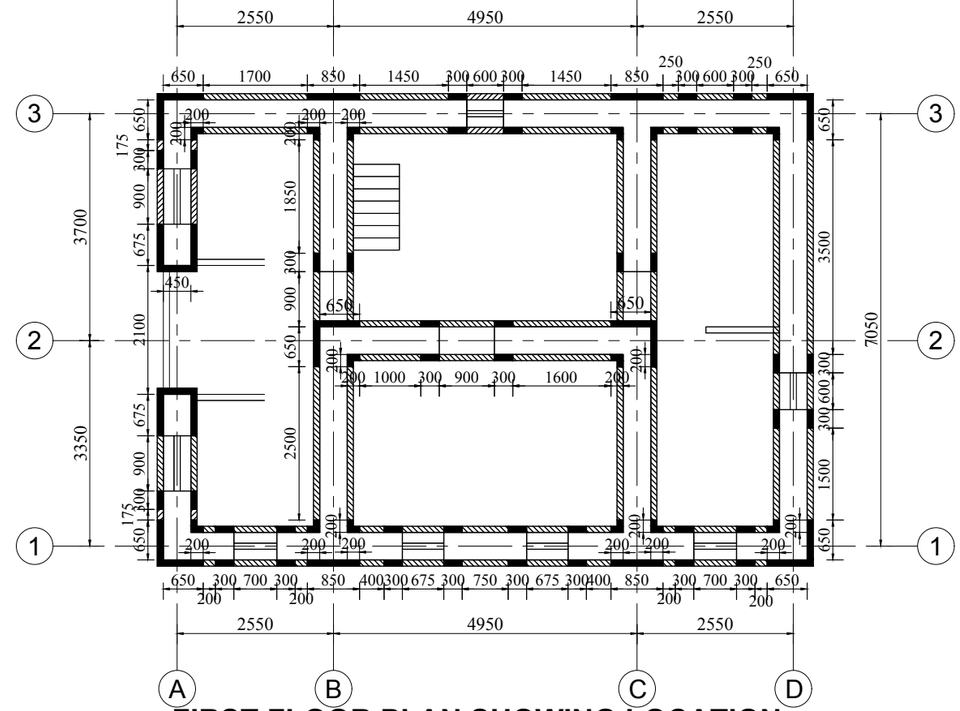
SECOND FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

Notes:

- Splint
  - 200mm width on each sides of corners and junctions using 3-8mmØ bars
  - 300mm width for sides of openings using 2-8mmØ + 1-4.75mmØ bars
- Jacketing on remaining walls using G.I. wire of 14SWG (2.03mm Ø) @ 100mm c/c both horizontally and vertically



GROUND FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

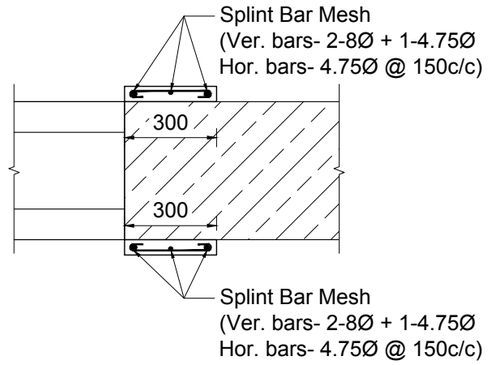
SHEET TITLE :-

FLOOR PLANS SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

SCALE :- 1:100 FOR A3 PAPER

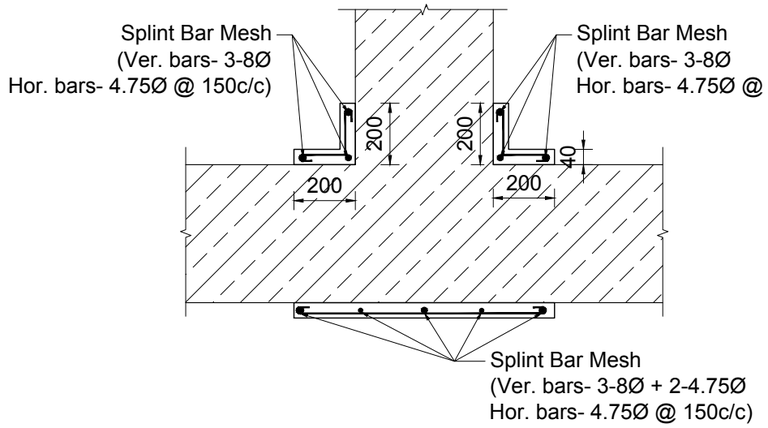
DATE :- JULY, 2017

06



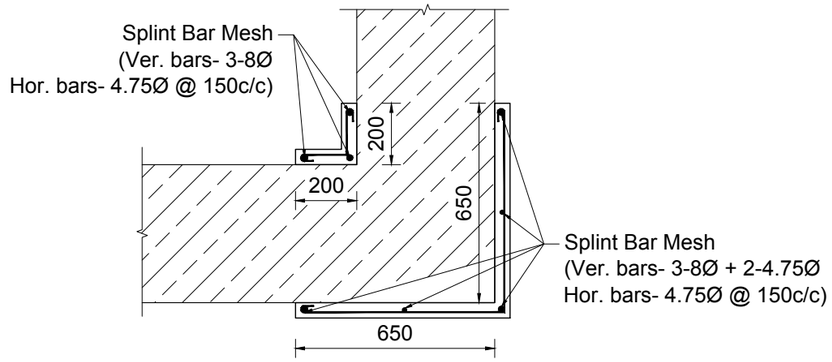
DETAIL SHOWING VERTICAL SPLINT AT SIDES OF OPENING

SCALE = 1:20



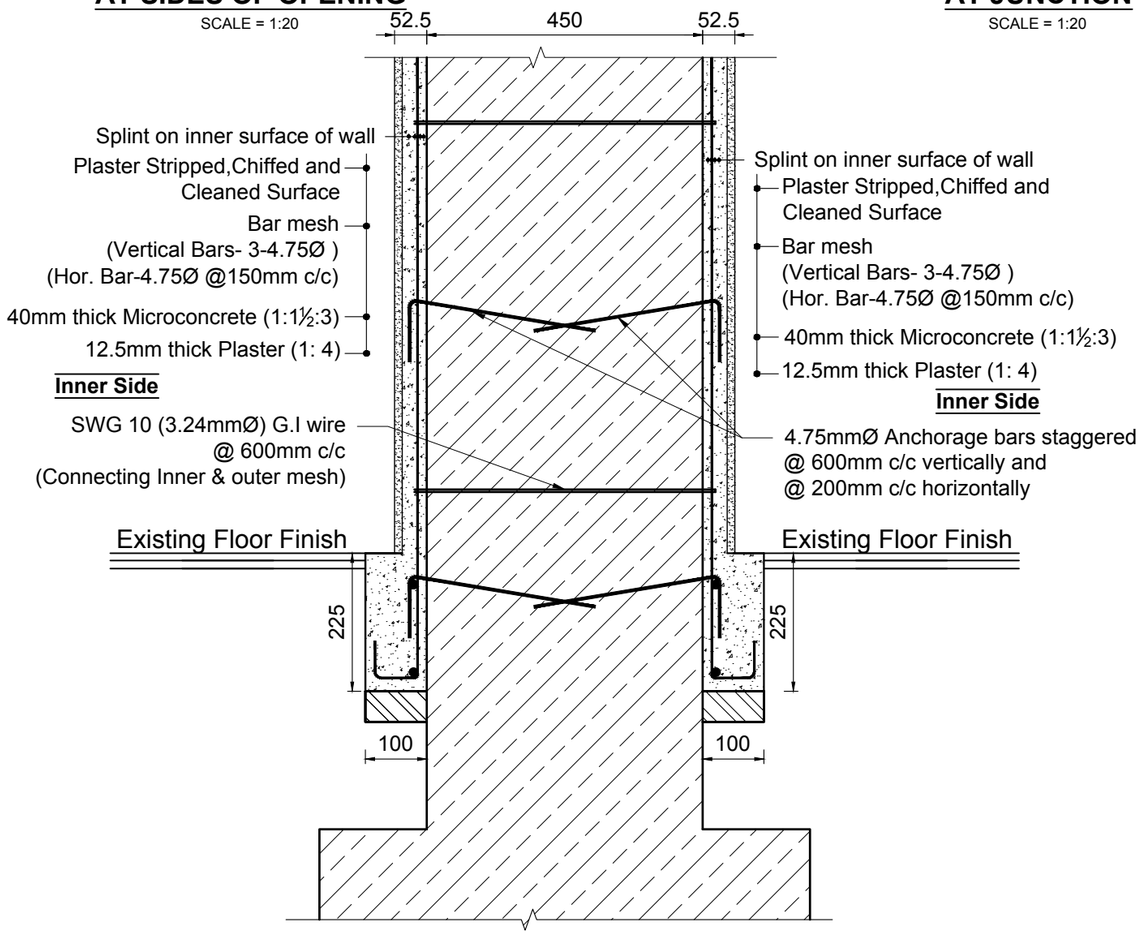
DETAIL SHOWING VERTICAL SPLINT AT JUNCTION

SCALE = 1:20



DETAIL SHOWING VERTICAL SPLINT AT CORNER

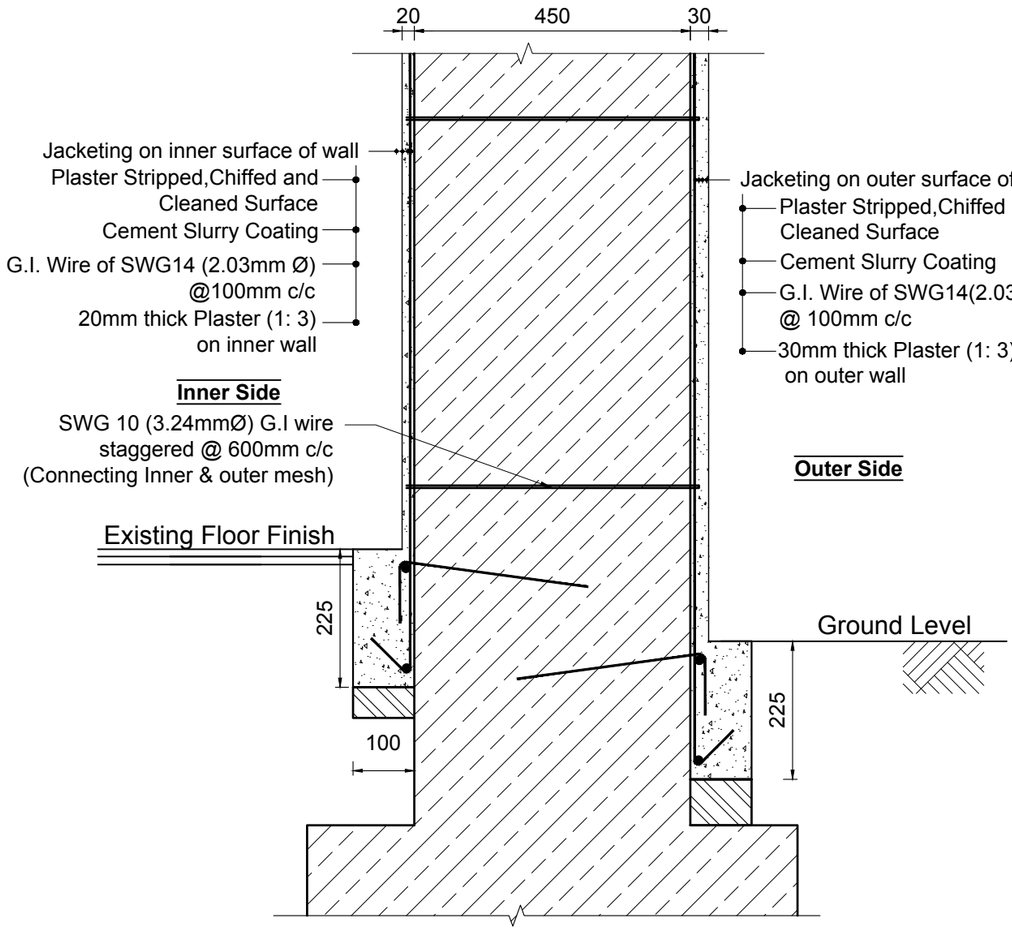
SCALE = 1:20



SECTION AT B1-B1

(DETAILS OF SPLINT ON BOTH SURFACES OF INTERNAL WALLS)

SCALE = 1:10



SECTION AT B2-B2

(DETAILS OF JACKETING ON BOTH SURFACES OF PERIPHERAL WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

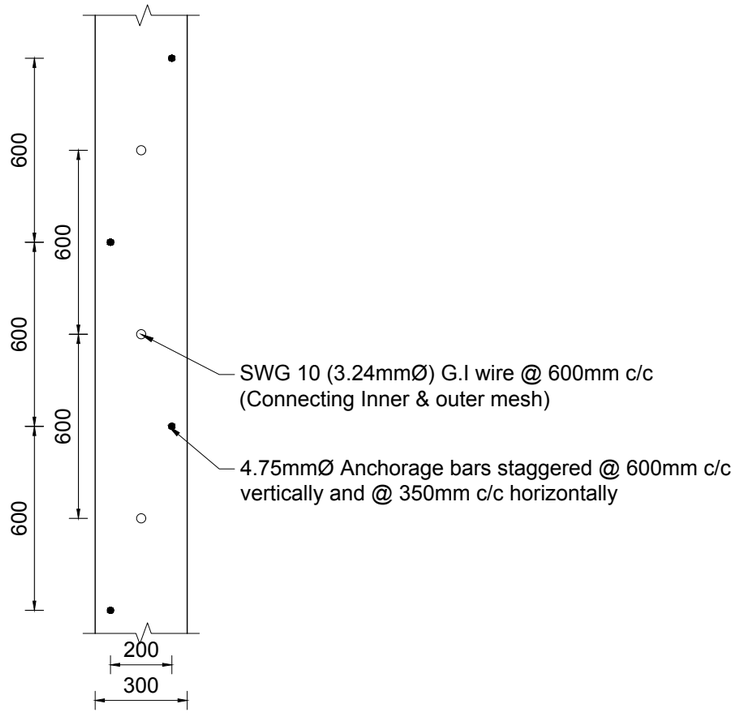
SHEET TITLE :-

DETAILS OF SPLINT AND JACKETING

SCALE :- I:20, I:10 FOR A3 PAPER

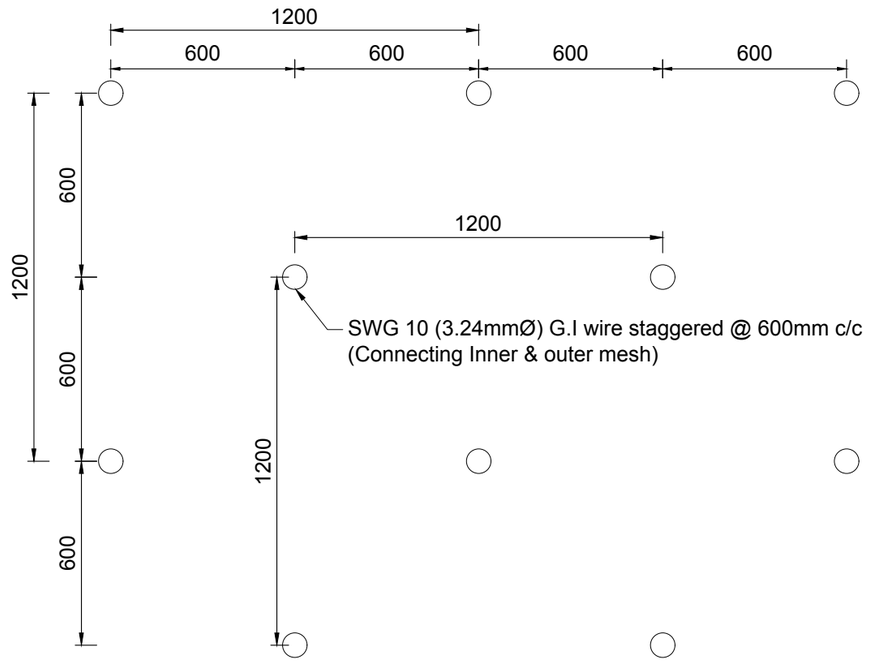
DATE :- JULY, 2017

07



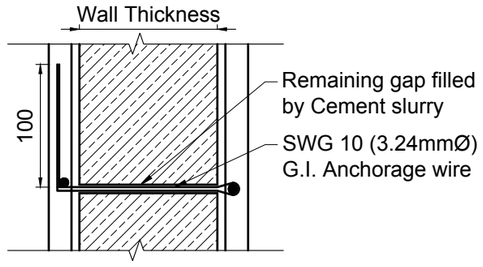
LAYOUT OF ANCHORAGE BARS FOR CONNECTING SPLINT BANDS ON BOTH SIDES OF WALLS

SCALE 1:20



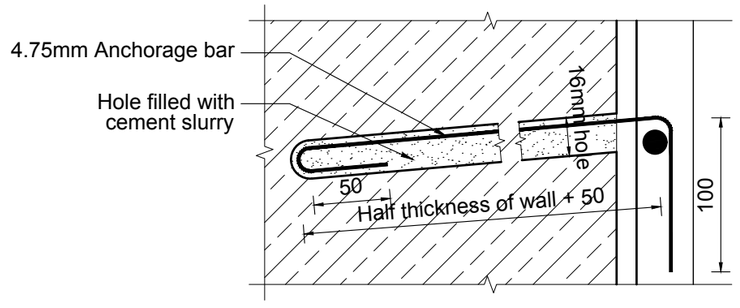
LAYOUT OF G.I. WIRE ANCHORAGE FOR CONNECTING JACKETING MESH ON BOTH SIDES OF WALL

SCALE 1:20



G.I. WIRE DETAILS

SCALE 1:10



ANCHORAGE BAR DETAILS

SCALE 1:4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

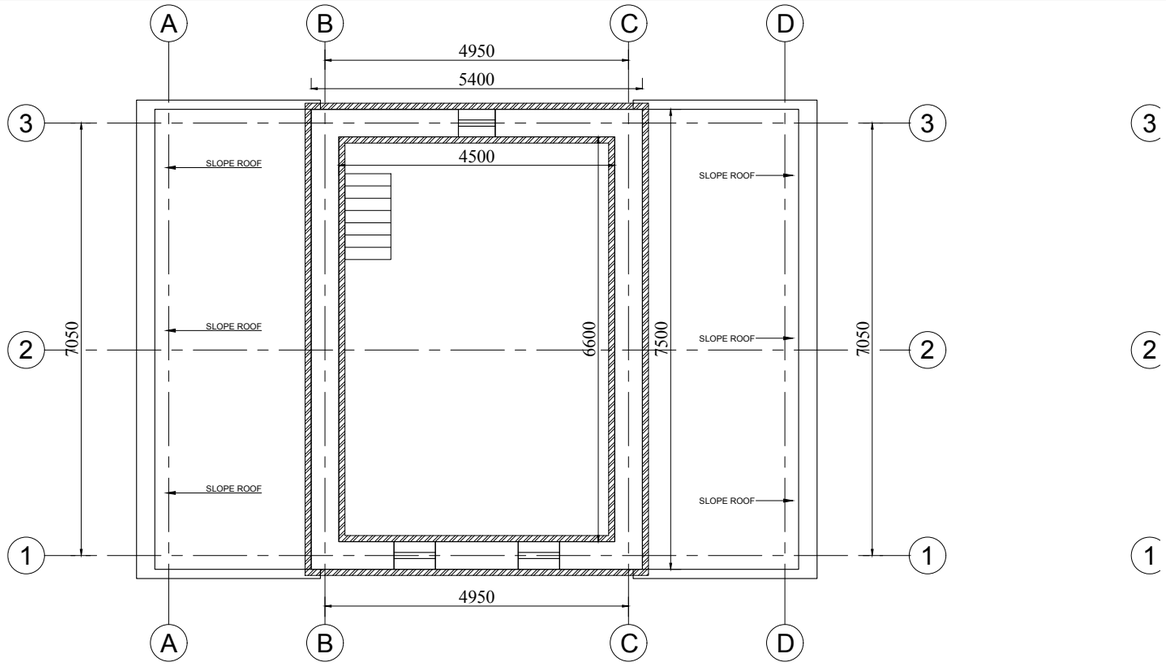
SHEET TITLE :-

DETAILS OF SPLINT AND JACKETING

SCALE :- 1:20, 1:10 FOR A3 PAPER

DATE :- JULY, 2017

08

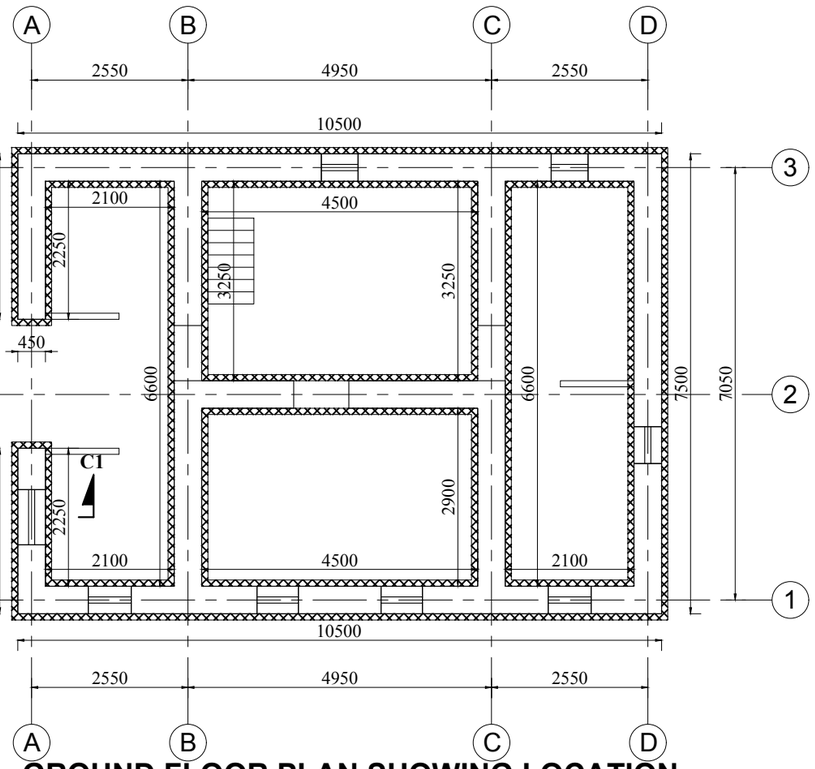


Notes:

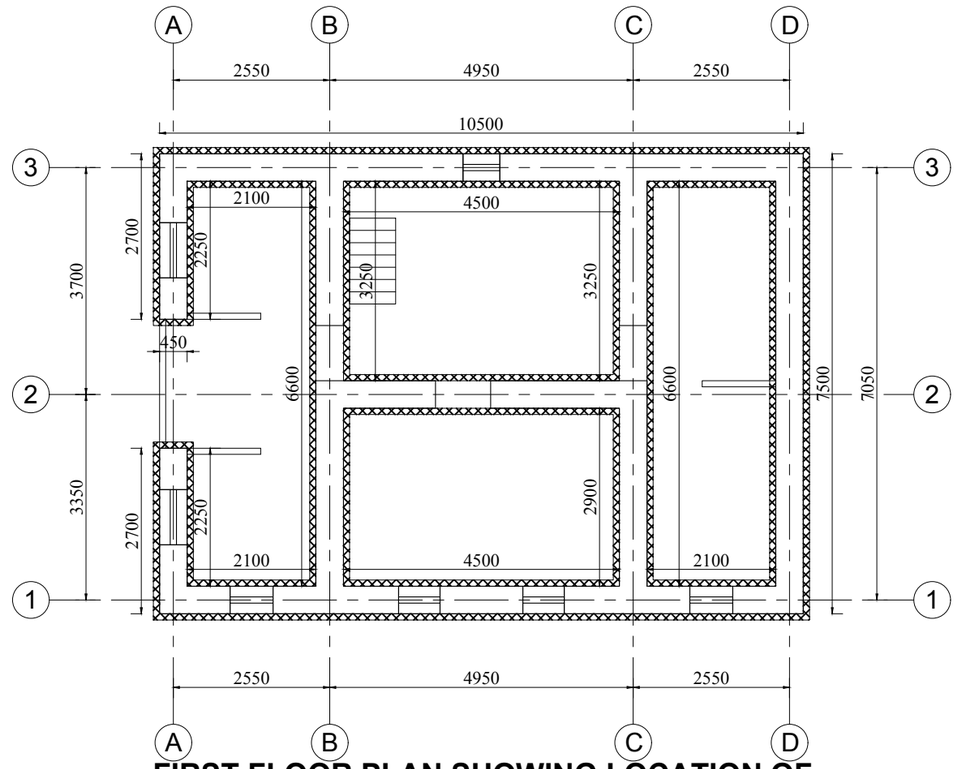
Horizontal Bands

- 200mm width using 2-4.75mmØ bars at sill level
- 300mm width using 3-4.75mmØ bars at lintel level

SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



GROUND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

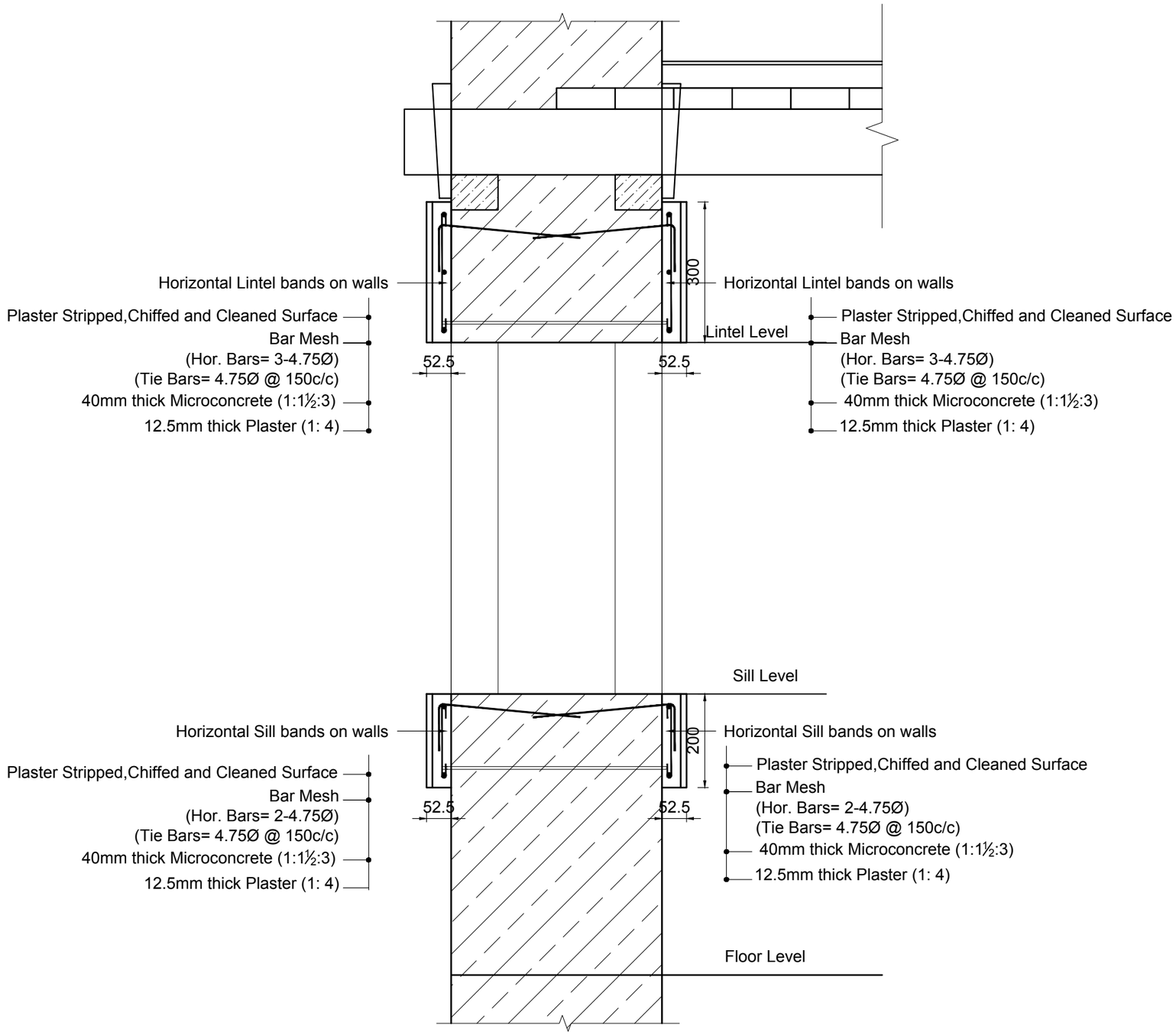
SHEET TITLE :-

FLOOR PLANS SHOWINGLOCATIONS OF HORIZONTAL BANDAGES AT FLOOR AND SILL LEVEL

09

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017



SECTION AT C1-C1

(DETAILS OF HORIZONTAL BANDAGES ON BOTH SURFACES OF WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

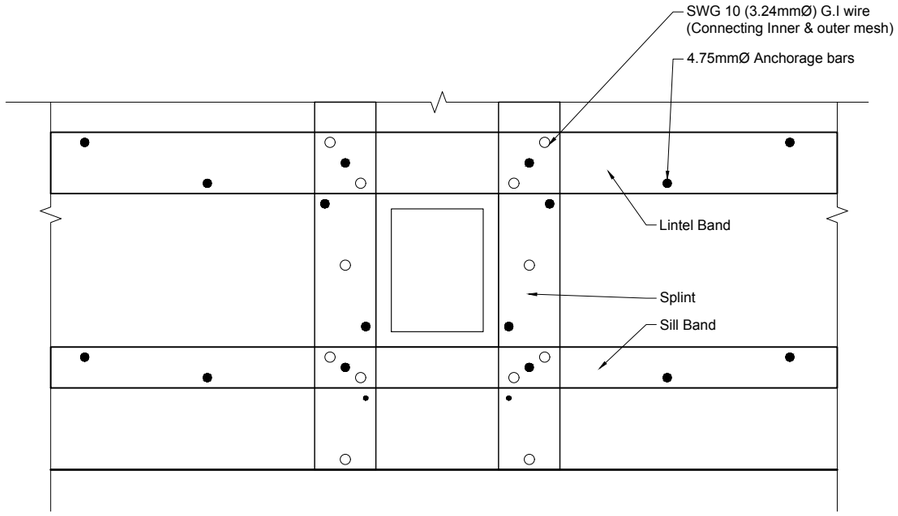
SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- 1:10 FOR A3 PAPER

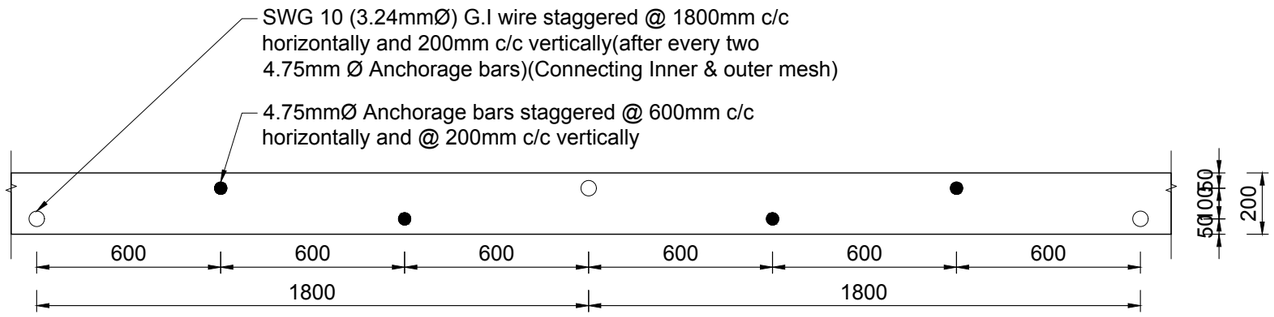
DATE :- JULY, 2017

10



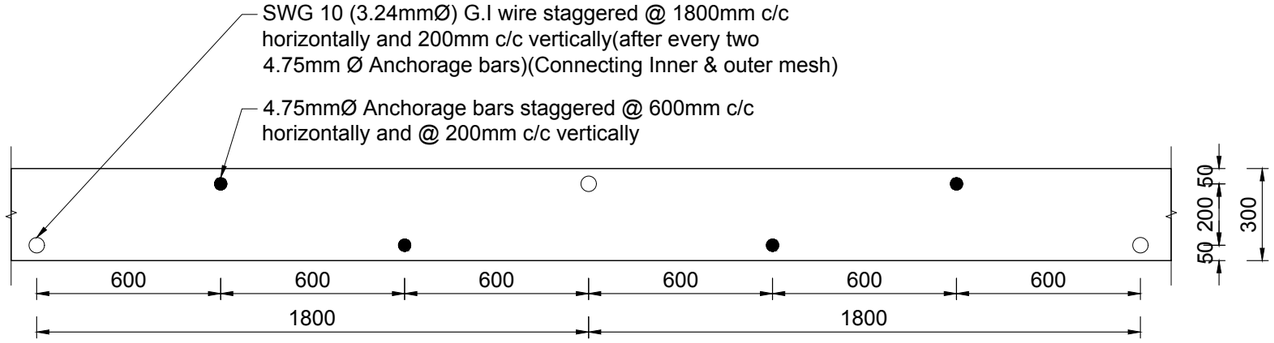
TYPICAL LAYOUT OF ANCHORAGE FOR CONNECTING SPLINT AND HORIZONTAL BANDAGE ON BOTH SIDES OF WALLS

SCALE 1:30



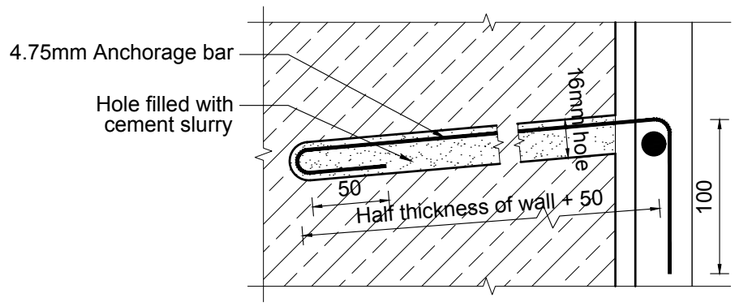
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT SILL LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



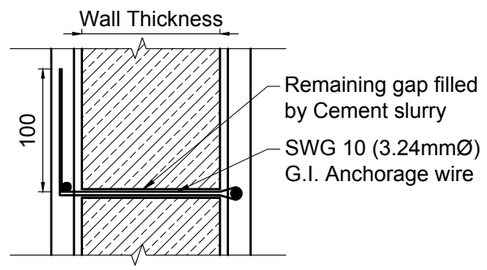
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT FLOOR LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



ANCHORAGE BAR DETAILS

SCALE 1:4



G.I. WIRE DETAILS

SCALE 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

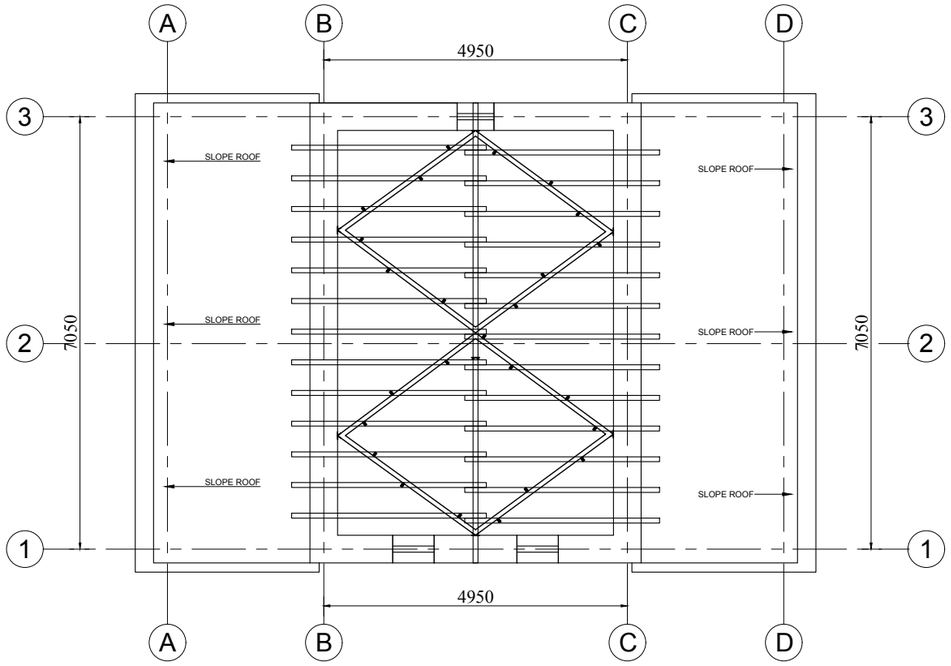
SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

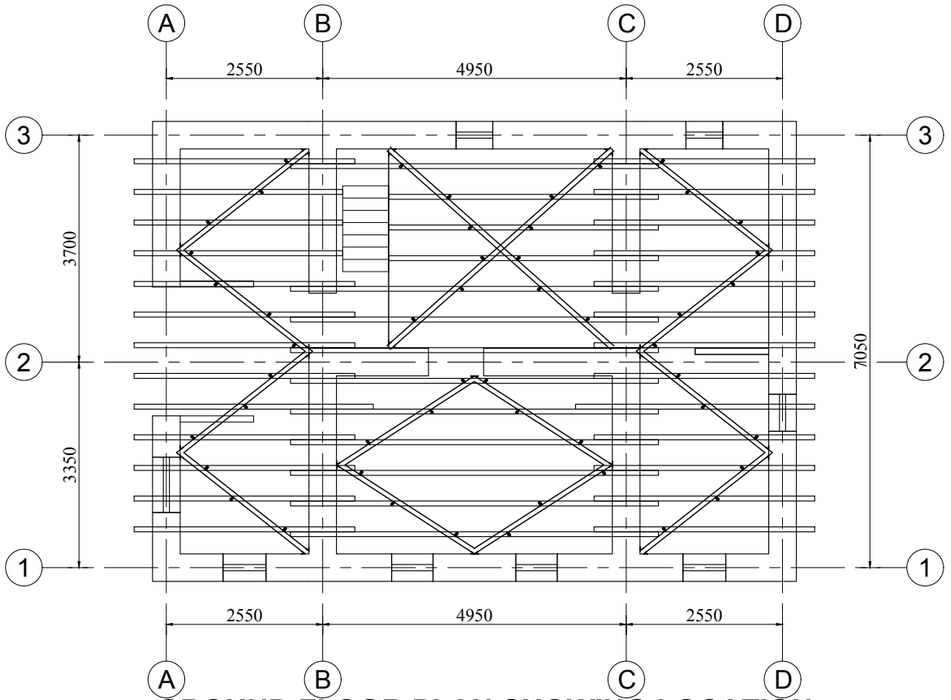
SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

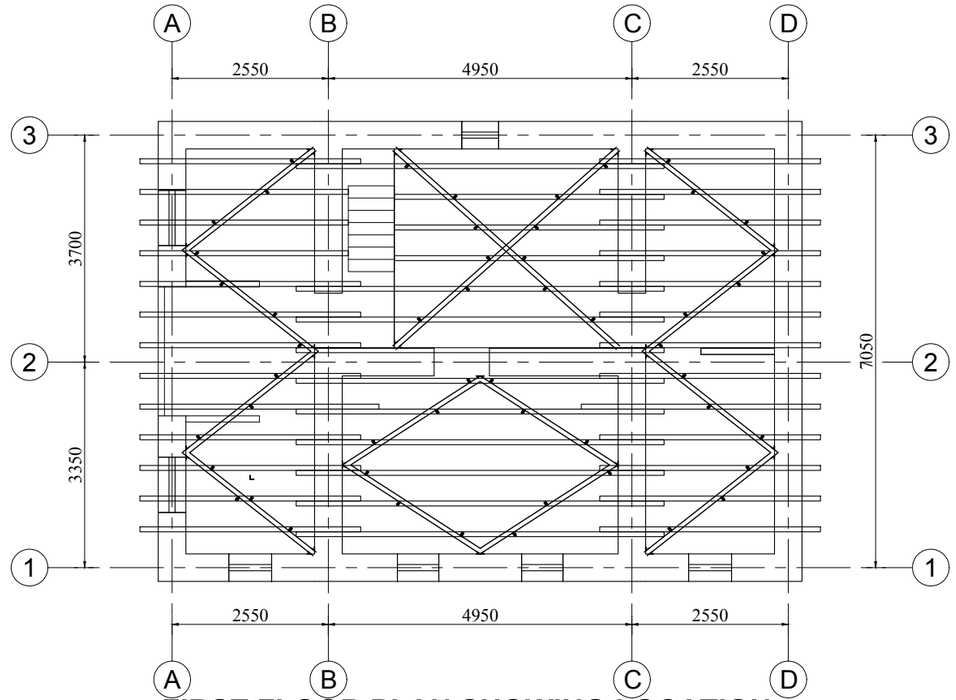
11



SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



GROUND FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF



FIRST FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF

PROJECT TITLE :-

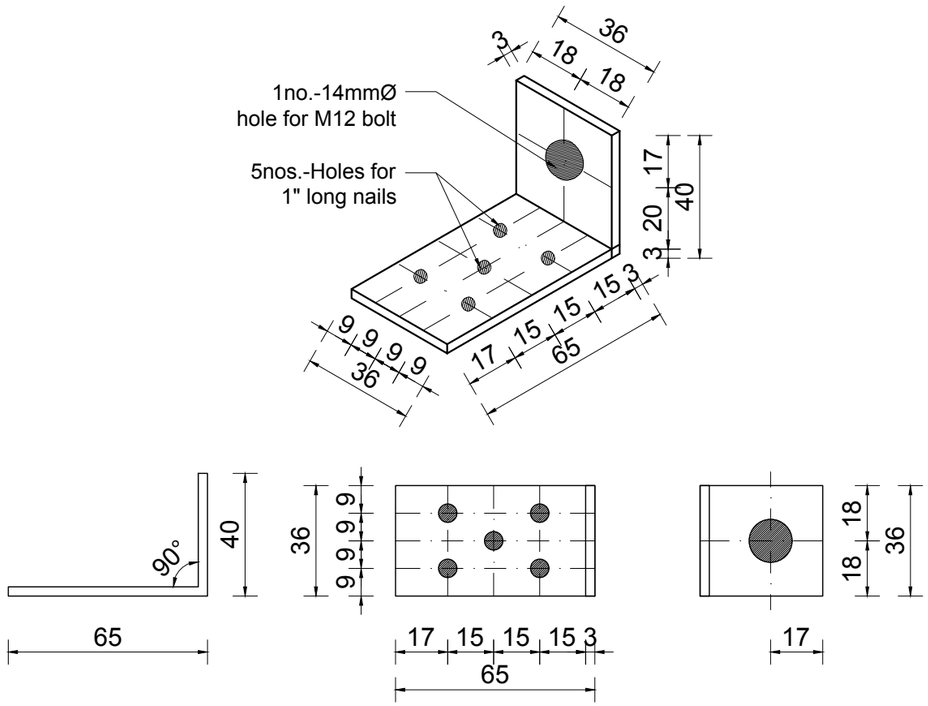
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

12

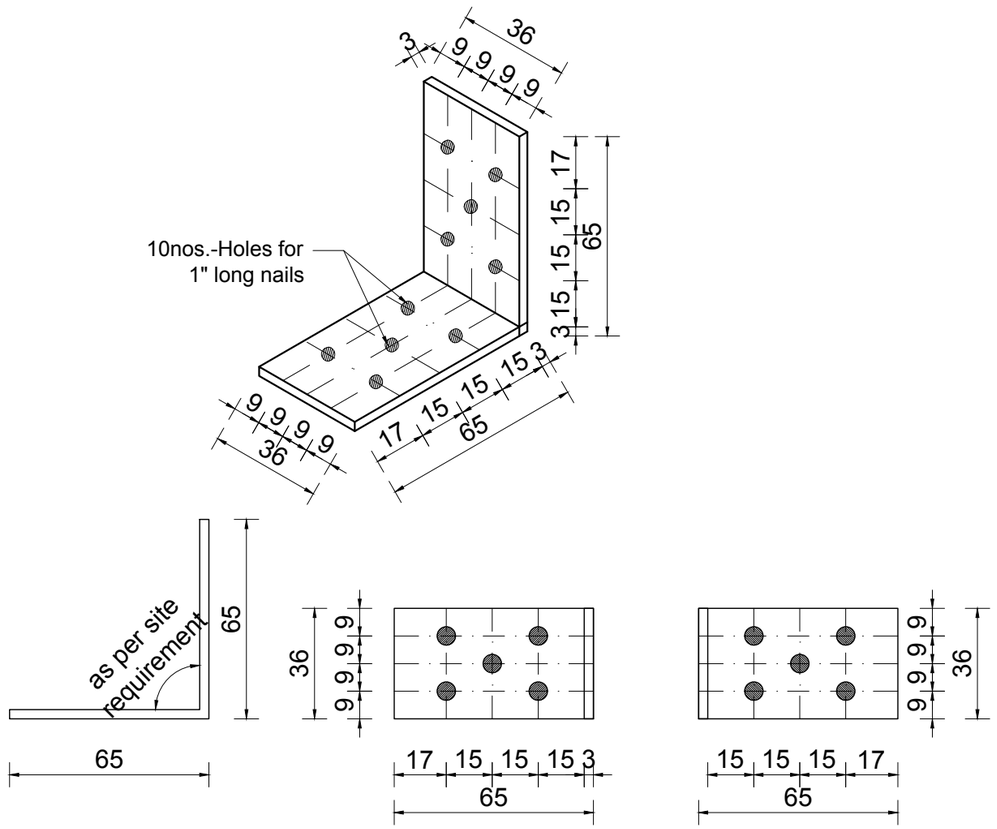
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017



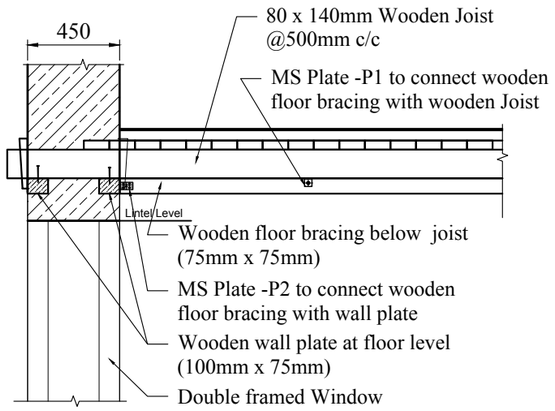
MS PLATE - P1

SCALE 1:2



MS PLATE - P2

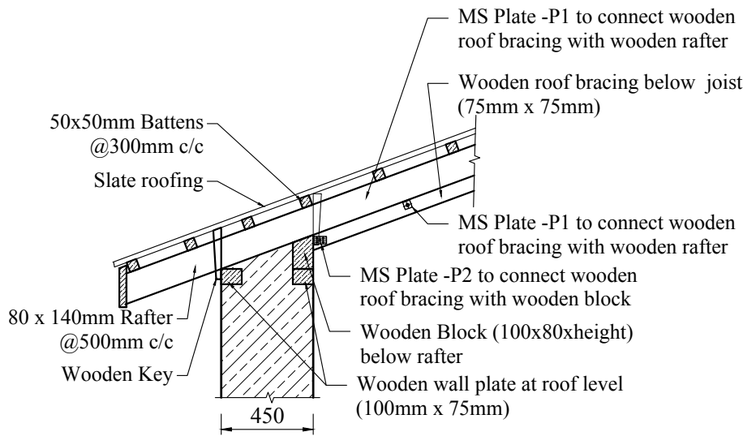
SCALE 1:2



DETAIL A1

SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL

SCALE = 1:30



DETAIL B1

SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL

SCALE = 1:30

PROJECT TITLE :-

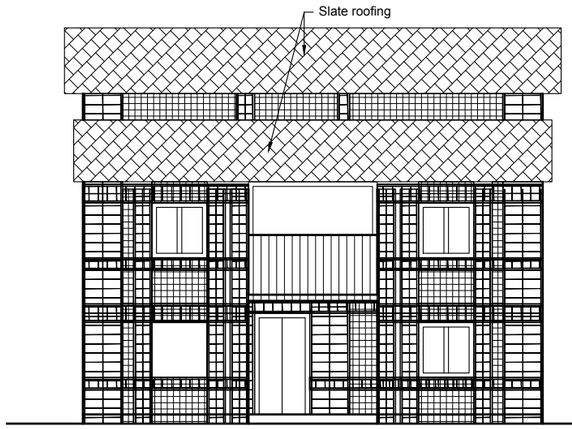
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

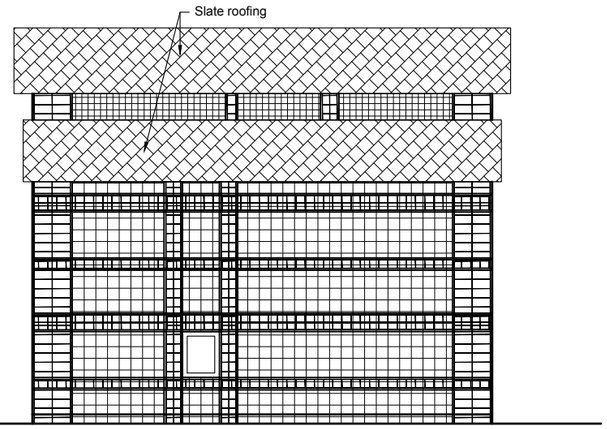
SCALE :- 1:30, 1:2 FOR A3 PAPER

DATE :- JULY, 2017

13

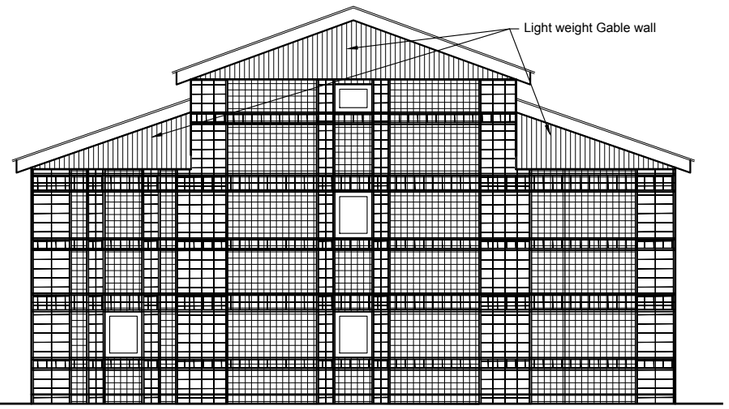


ELEVATION-1



ELEVATION-3

ELEVATION-2



ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING RC BARS AND G.I. WIRE MESH

SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING AFTER RETROFIT

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

14

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN ON TWO STOREY STONE MASONRY BUILDING IN MUD USING G.I. WIREMESH

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

SHEET TITLE :-

COVER PAGE

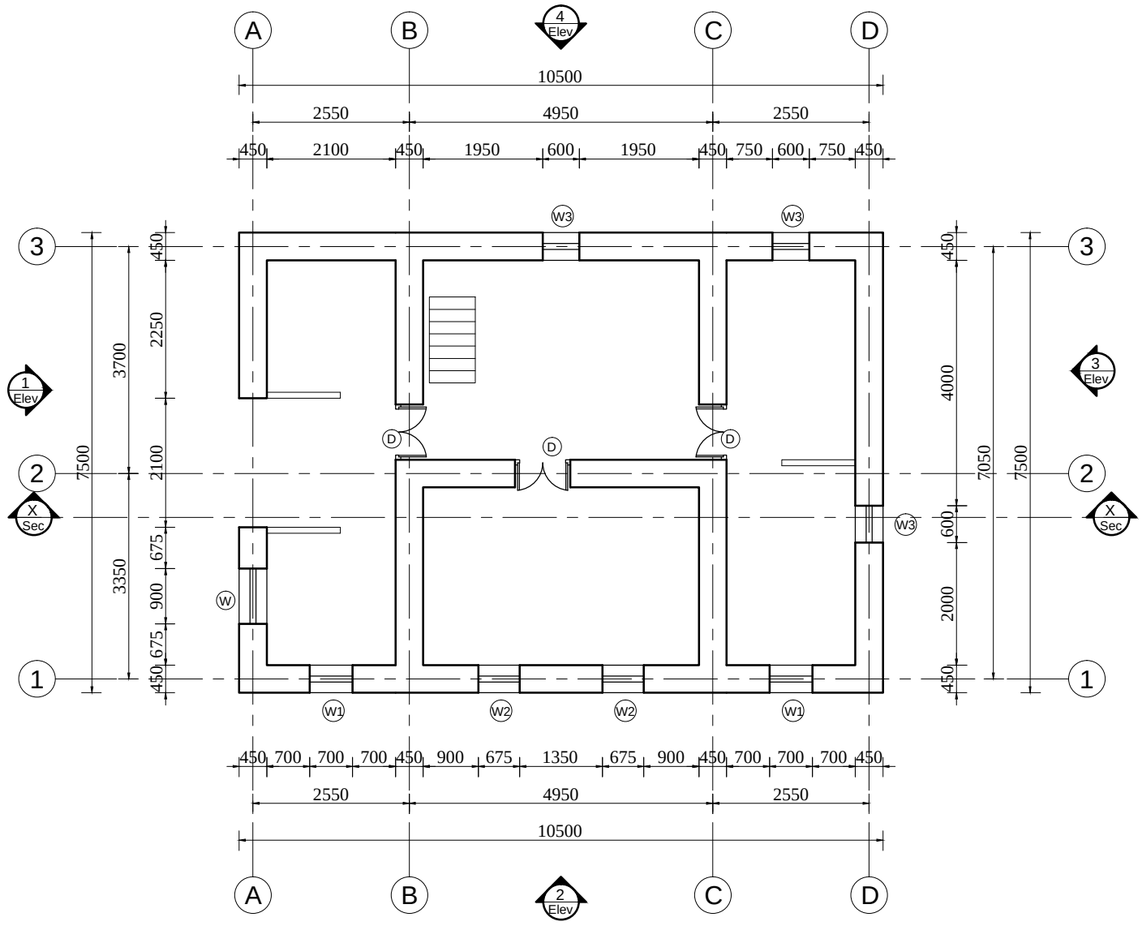
SCALE :- N/A

DATE :- JULY, 2017

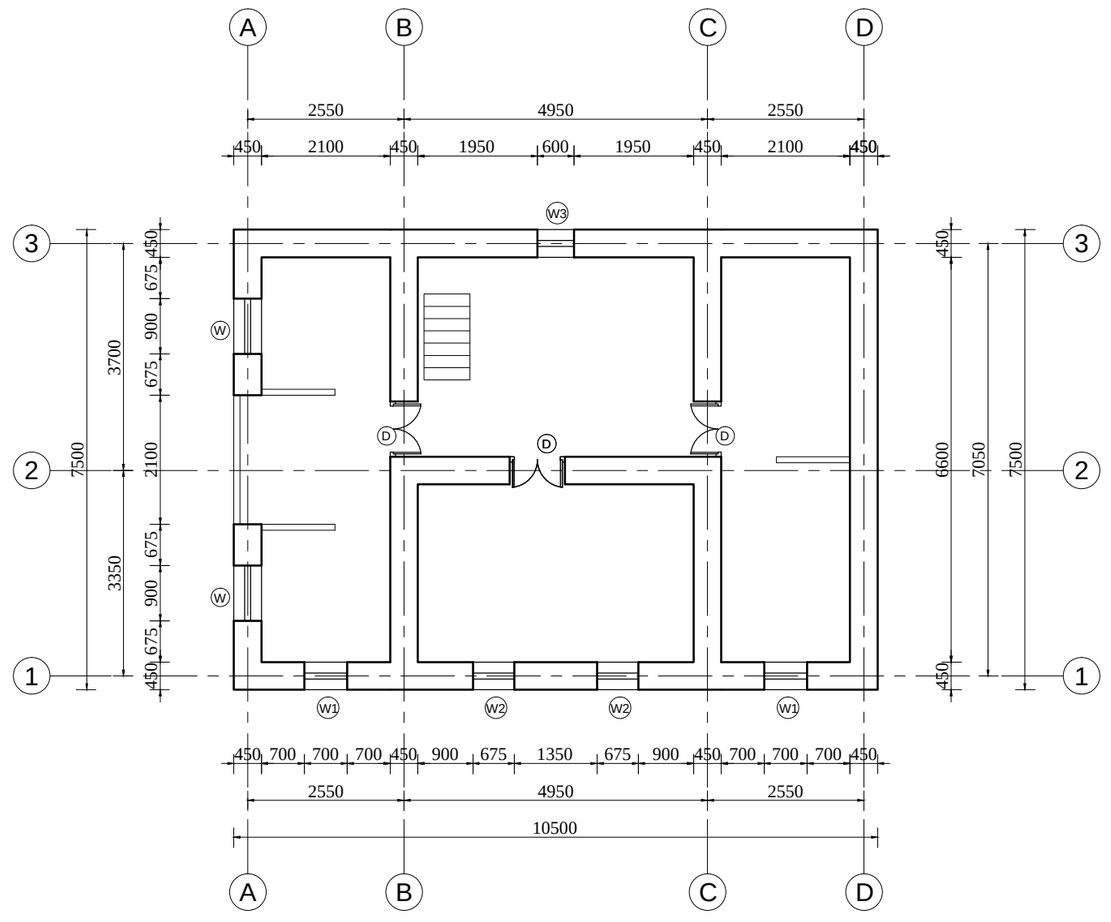
0

OPENING SCHEDULE

S.N.	SYMBOL	NOS.	SIZE	SILL HEIGHT
1.	DOOR-D	6	900 x 1650	---
2.	WINDOW-W	3	900 x 900	600
3.	WINDOW-W1	4	700 x 750	600
4.	WINDOW-W2	6	675 x 750	600
5.	WINDOW-W3	6	600 x 750	600



GROUND FLOOR PLAN



FIRST FLOOR PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

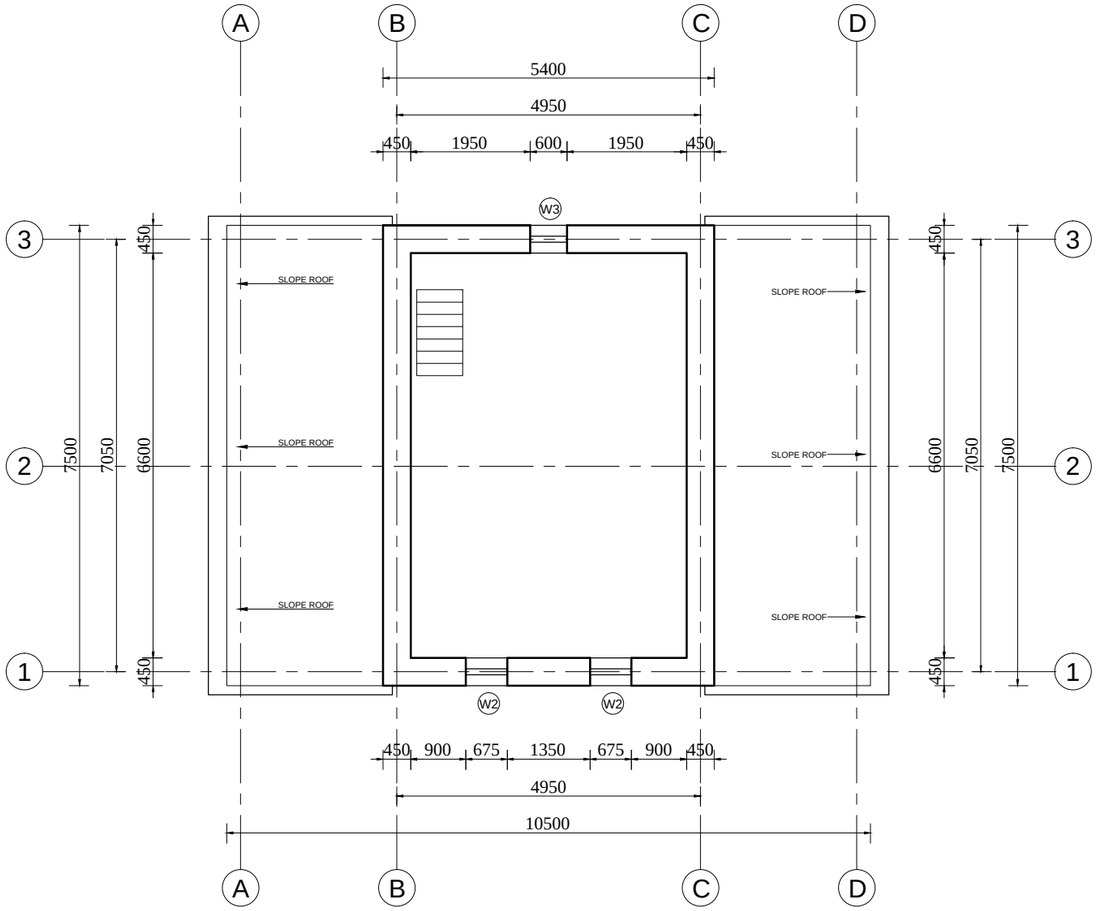
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

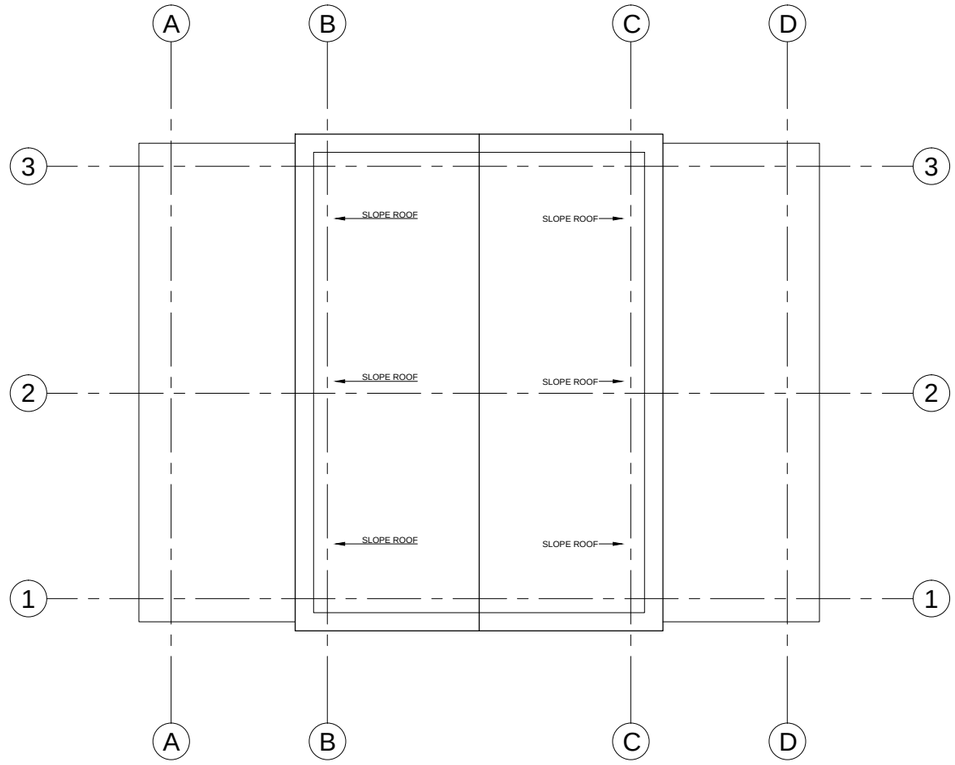
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

01



SECOND FLOOR PLAN



ROOF PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

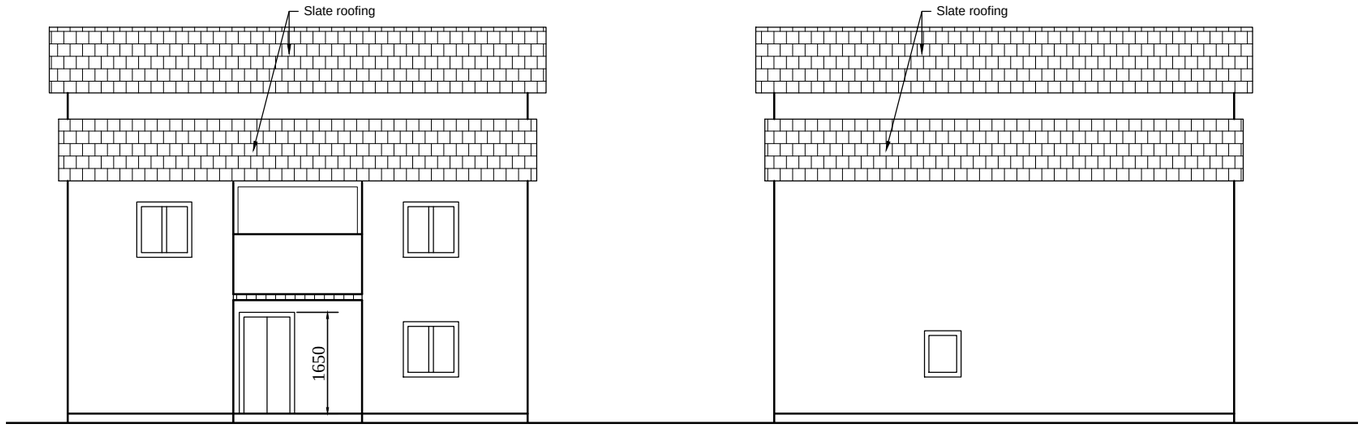
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

SCALE :- 1:100 FOR A3 PAPER

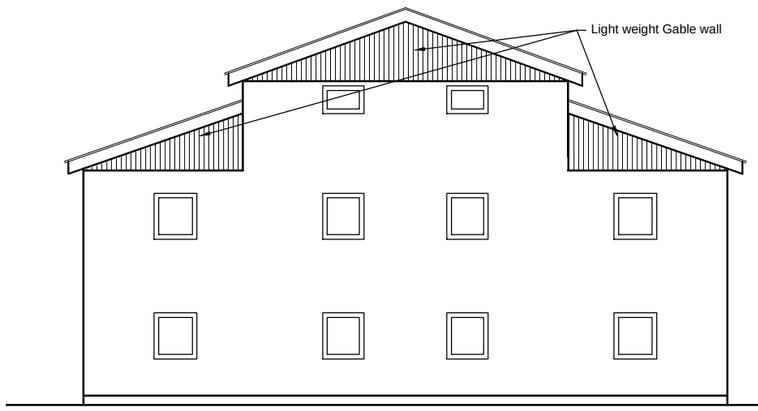
DATE :- JULY, 2017

02



ELEVATION-1

ELEVATION-3



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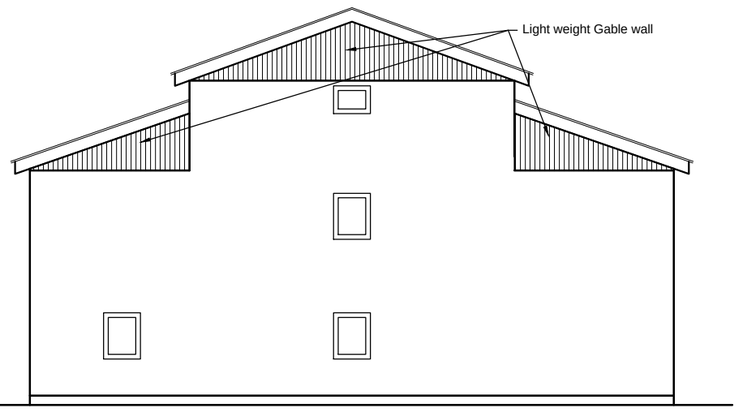


ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

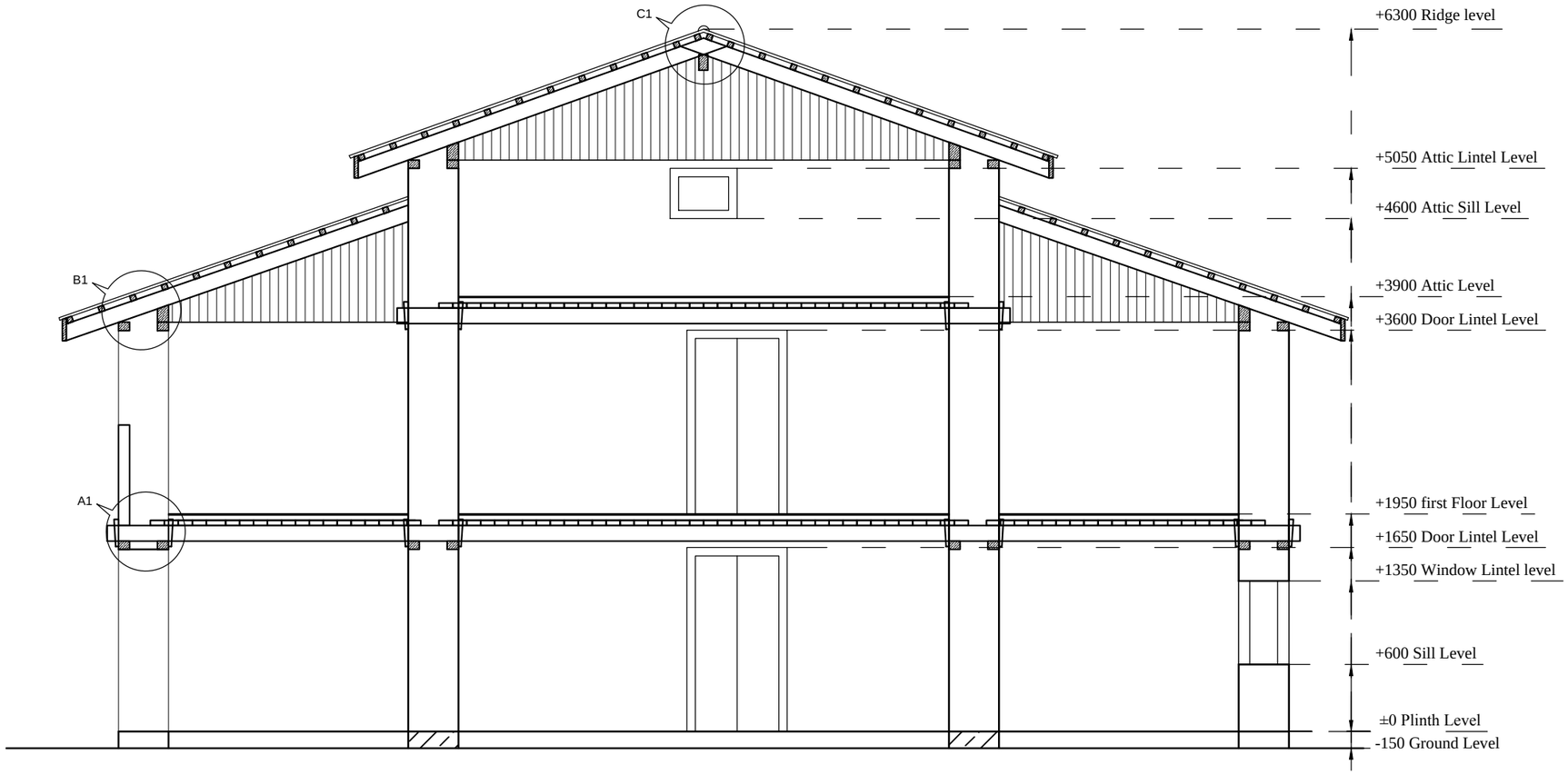
SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING

SCALE :- 1:100 FOR A3 PAPER

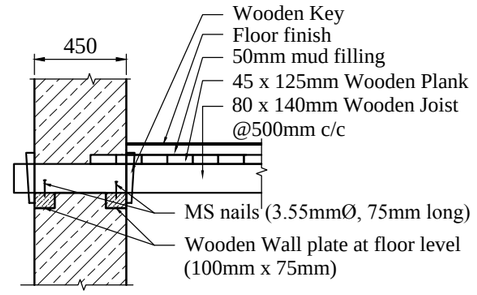
DATE :- JULY, 2017

03



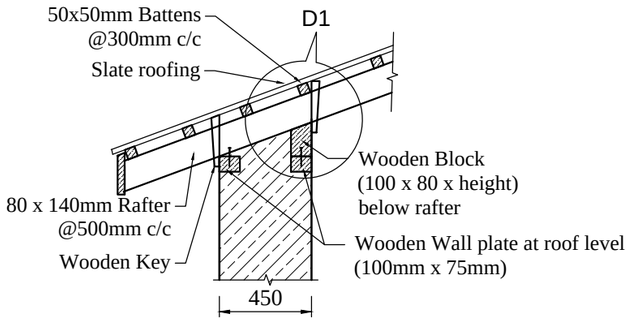
SECTION AT X-X

SCALE = 1:50



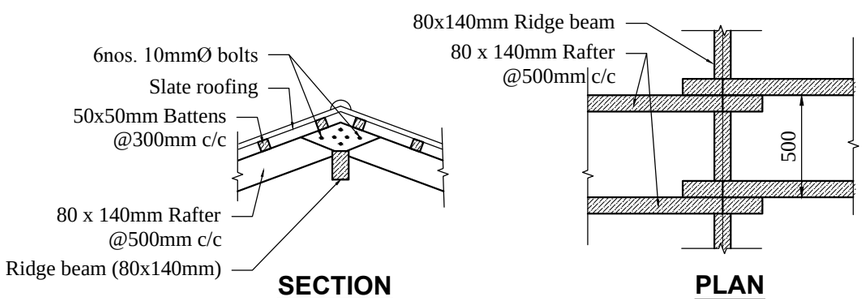
DETAIL A1
SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL

SCALE = 1:30



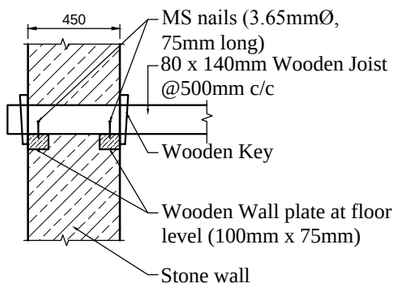
DETAIL B1
SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL

SCALE = 1:30



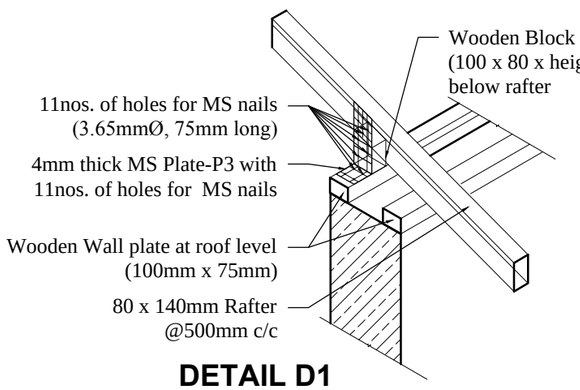
DETAIL C1
SHOWING ROOF DETAILS AT RIDGE LEVEL

SCALE = 1:30



FIXING OF JOISTS

SCALE = 1:30



DETAIL D1
SHOWING CONNECTION OF RAFTER WITH ROOF BAND

SCALE = 1:30

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

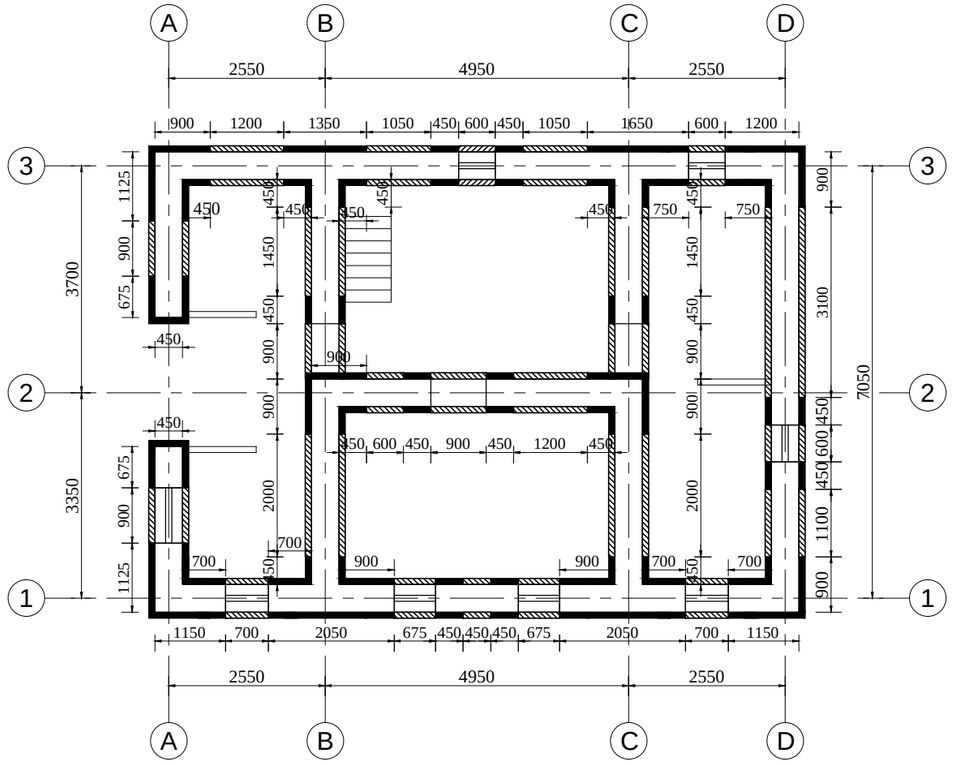
SHEET TITLE :-

SECTION OF EXISTING BUILDING AND DETAILS

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

04

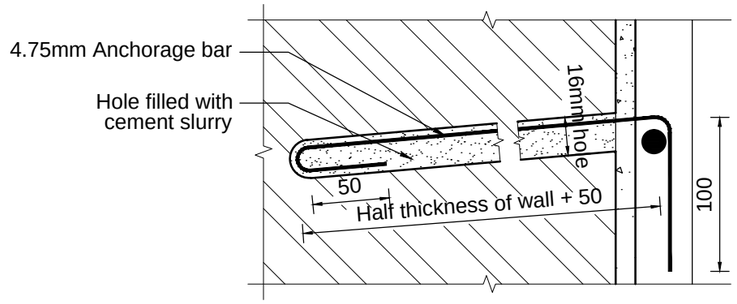


GROUND FLOOR PLAN SHOWING TIE BEAM FOR SPLINT AND JACKETING

SCALE = 1:100

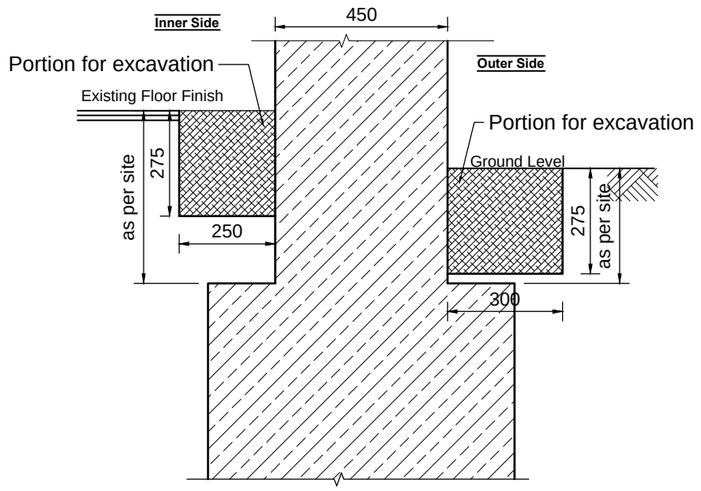
Notes:

- Tie beam for Splint of 450mm width on walls using G.I. welded wiremesh of 14SWG (2.03mm Ø) and size 25x25mm.
- Tie beam for Jacketing on remaining walls using G.I. wire of 14SWG (2.03mm Ø) @ 100mm c/c both horizontally and vertically



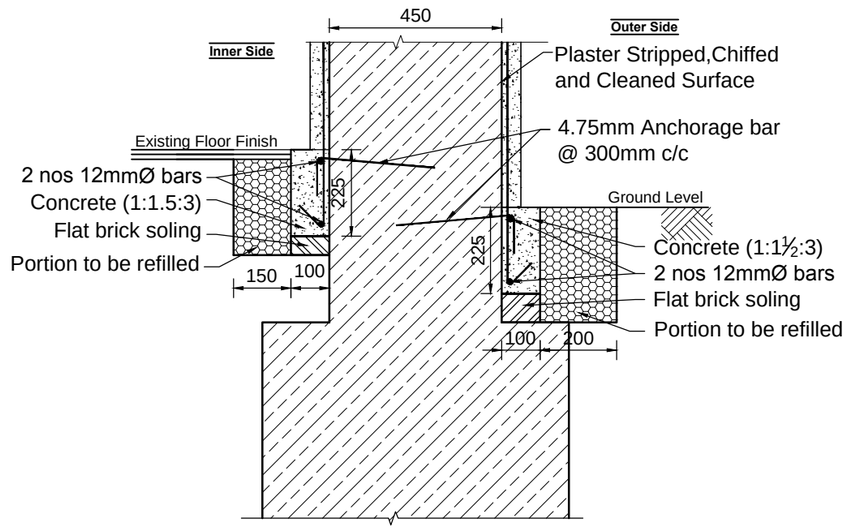
4.75 MM ANCHORAGE BAR DETAILS

SCALE 1:4



SECTION SHOWING THE PORTION TO BE EXCAVATED FOR TIE BEAM

SCALE = 1:16



DETAILS OF TIE BEAM FOR INNER AND OUTER SIDE OF THE WALL

SCALE = 1:16

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

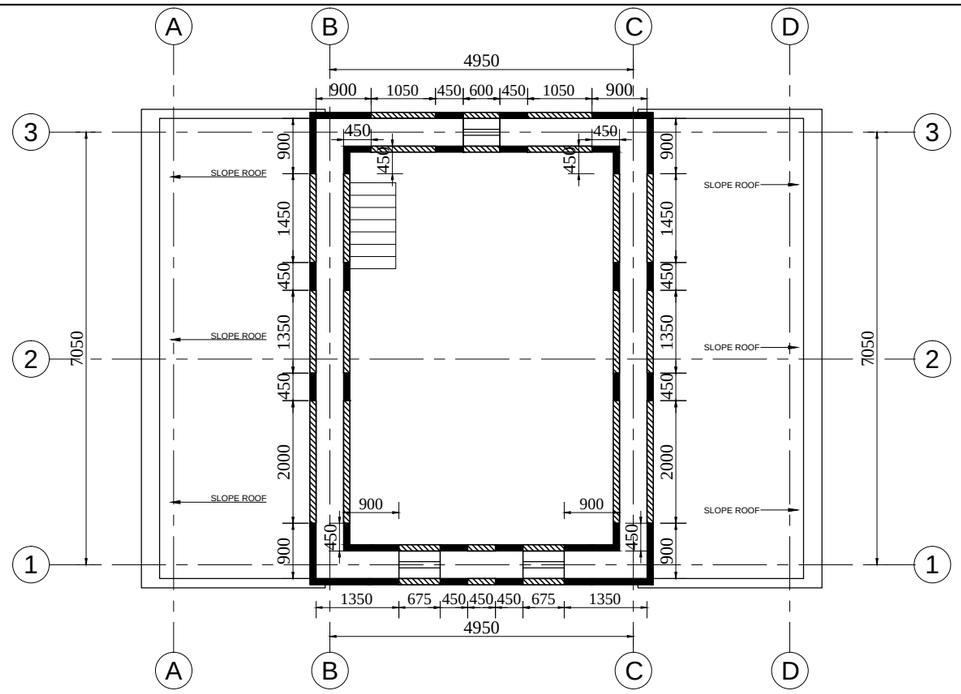
SHEET TITLE :-

TIE BEAM AND DETAILS

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

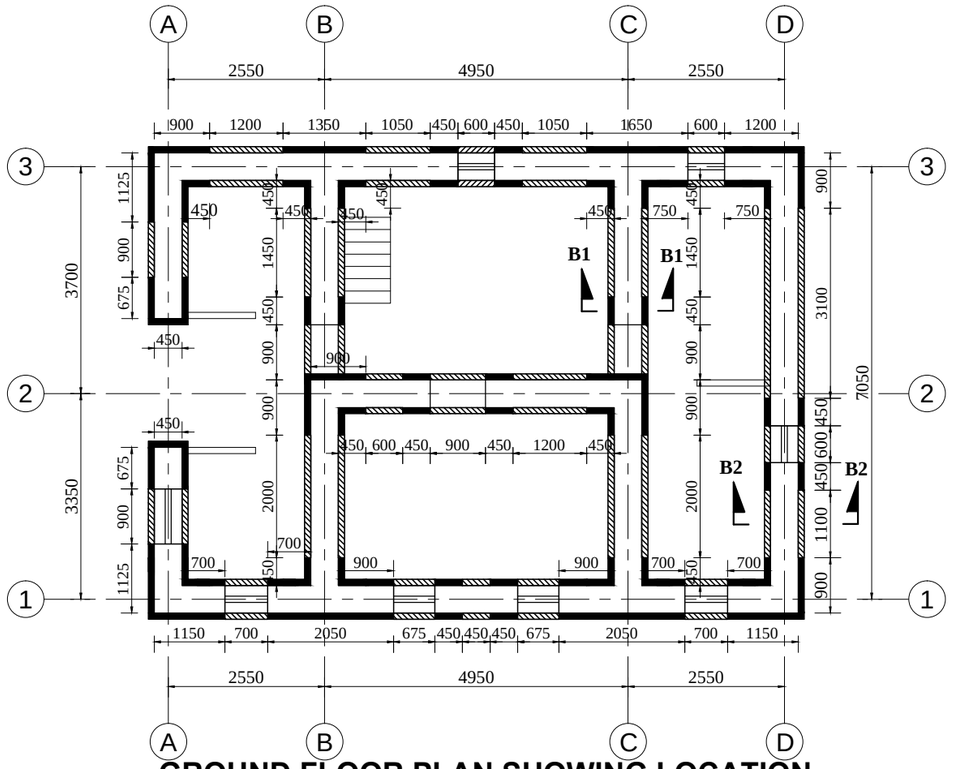
05



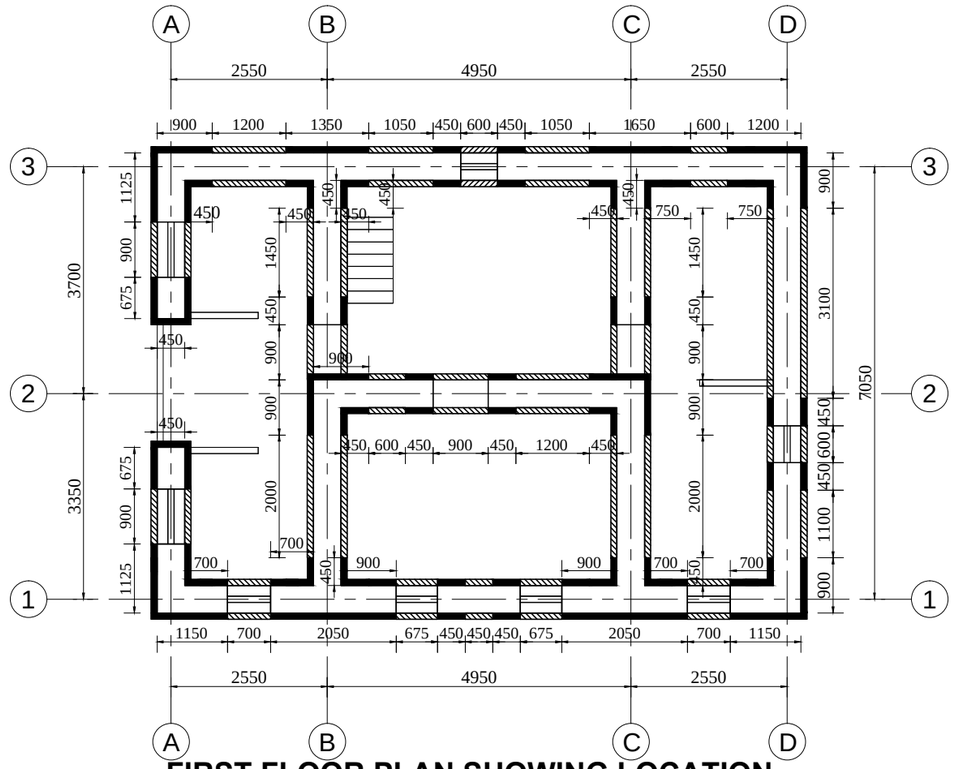
SECOND FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

Notes:

- Splint of 450mm width on walls using G.I. welded wiremesh of 14SWG (2.03mm Ø) and size 25x25mm.
- Jacketing on remaining walls using G.I. wire of 14SWG (2.03mm Ø) @ 100mm c/c both horizontally and vertically



GROUND FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

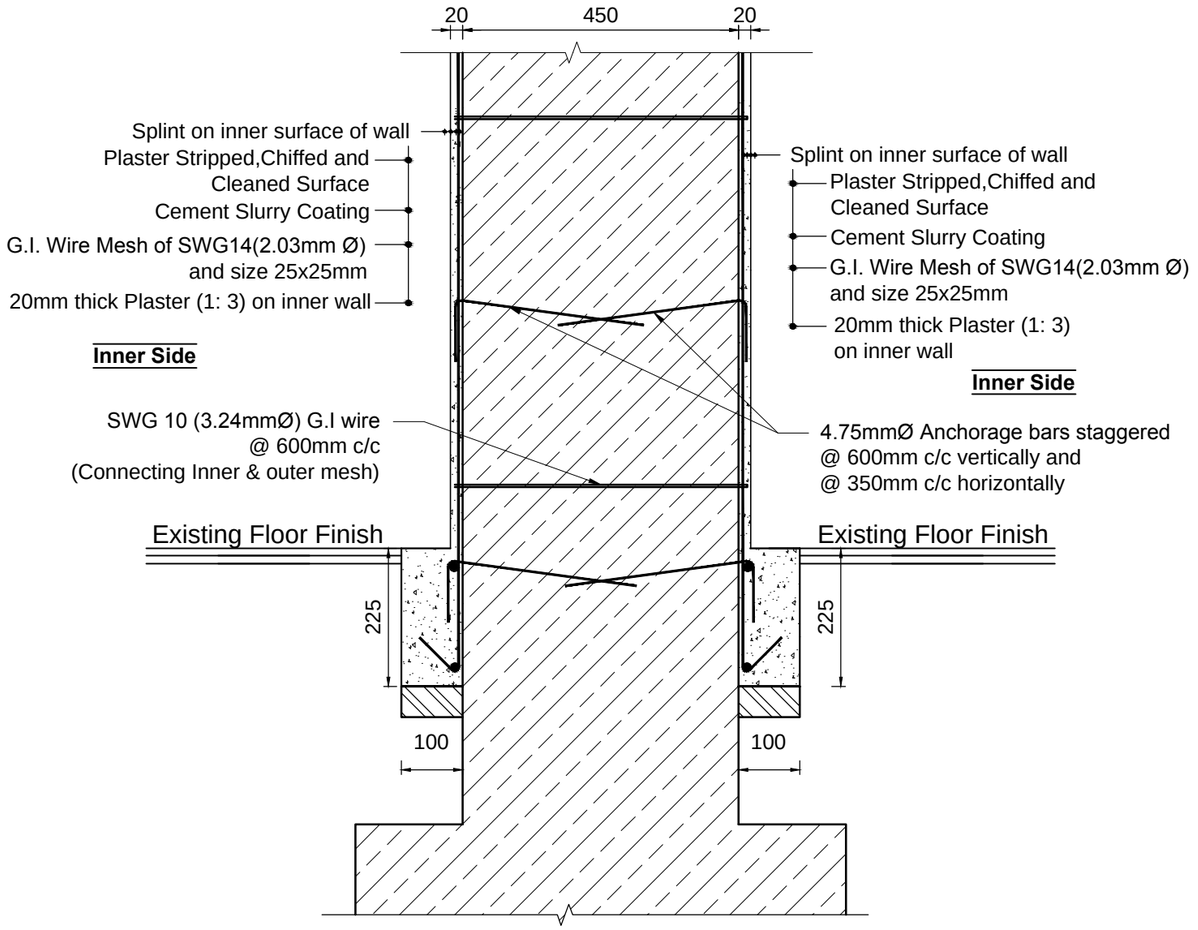
SHEET TITLE :-

FLOOR PLANS SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

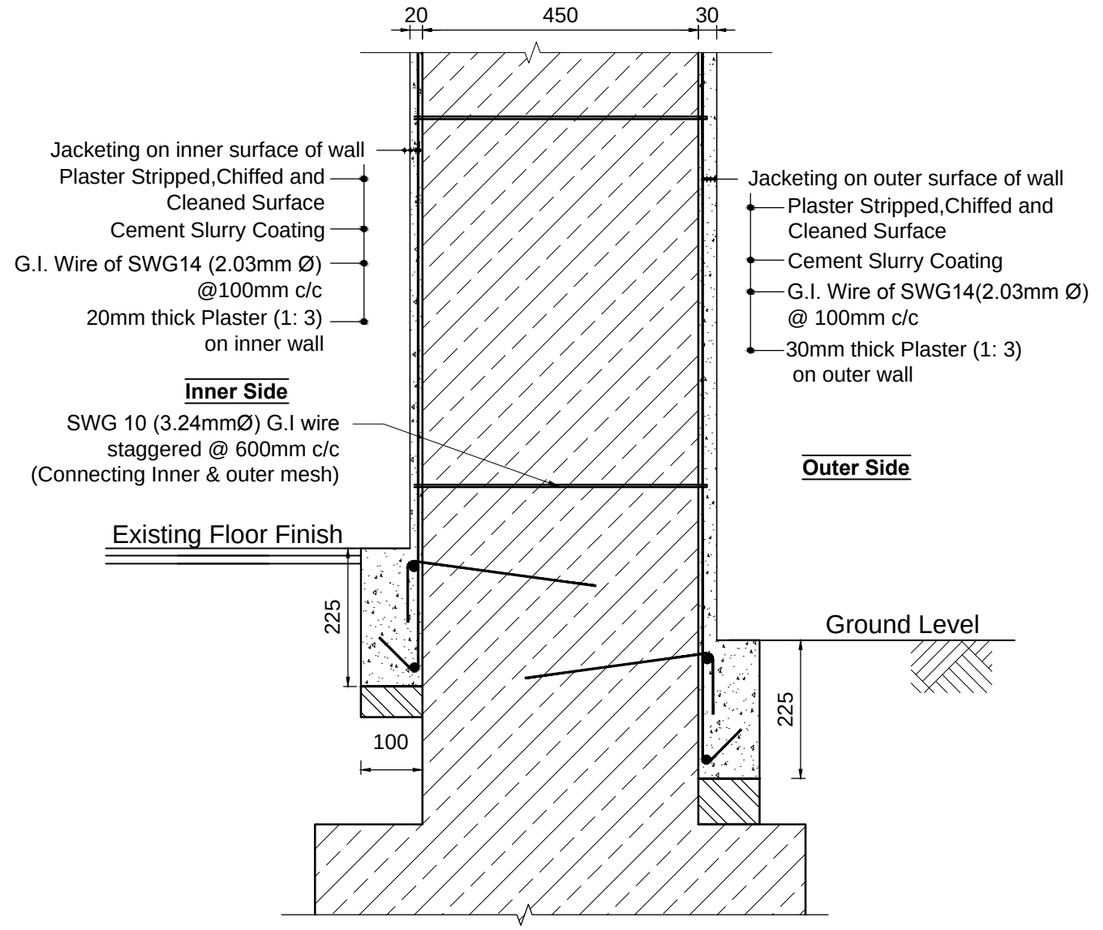
06



SECTION AT B1-B1

(DETAILS OF SPLINT ON BOTH SURFACES OF INTERNAL WALLS)

SCALE = 1:10



SECTION AT B2-B2

(DETAILS OF JACKETING ON BOTH SURFACES OF PERIPHERAL WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

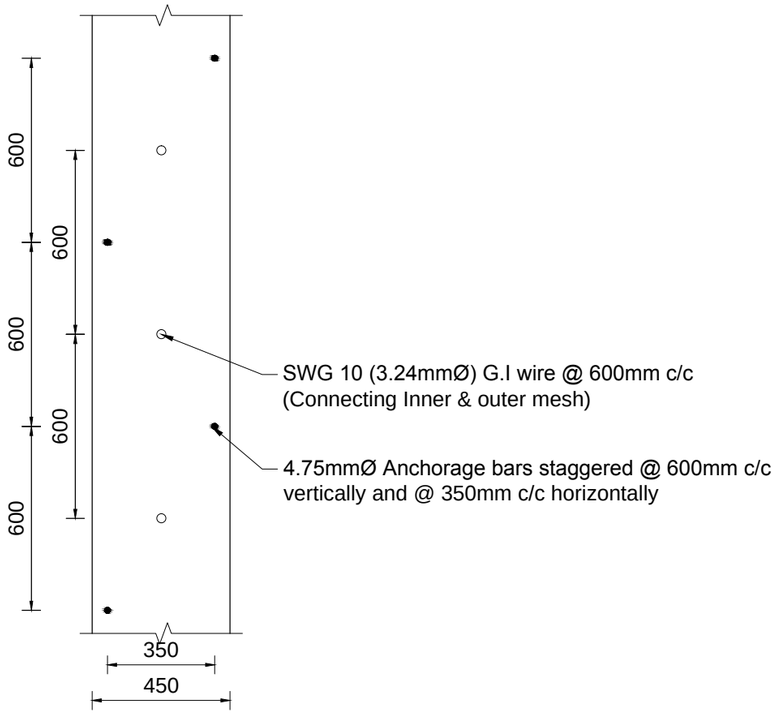
SHEET TITLE :-

DETAILS OF SPLINT AND JACKETING

SCALE :- 1:10 FOR A3 PAPER

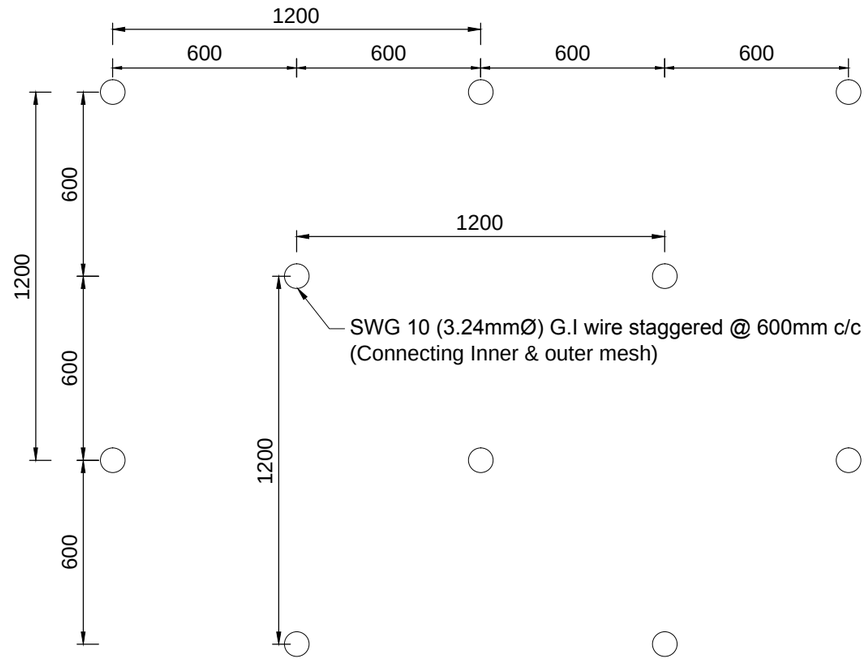
DATE :- JULY, 2017

07



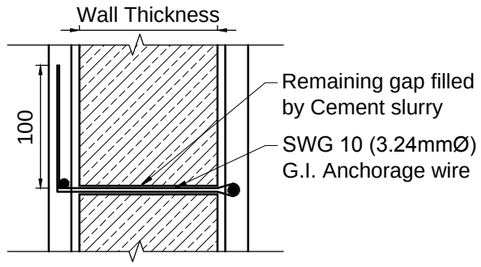
LAYOUT OF ANCHORAGE BARS FOR CONNECTING SPLINT BANDS ON BOTH SIDES OF WALLS

SCALE 1:20



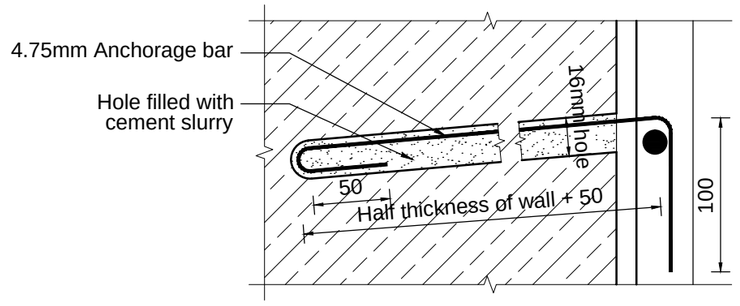
LAYOUT OF G.I. WIRE ANCHORAGE FOR CONNECTING JACKETING MESH ON BOTH SIDES OF WALL

SCALE 1:20



G.I. WIRE DETAILS

SCALE 1:10



ANCHORAGE BAR DETAILS

SCALE 1:4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

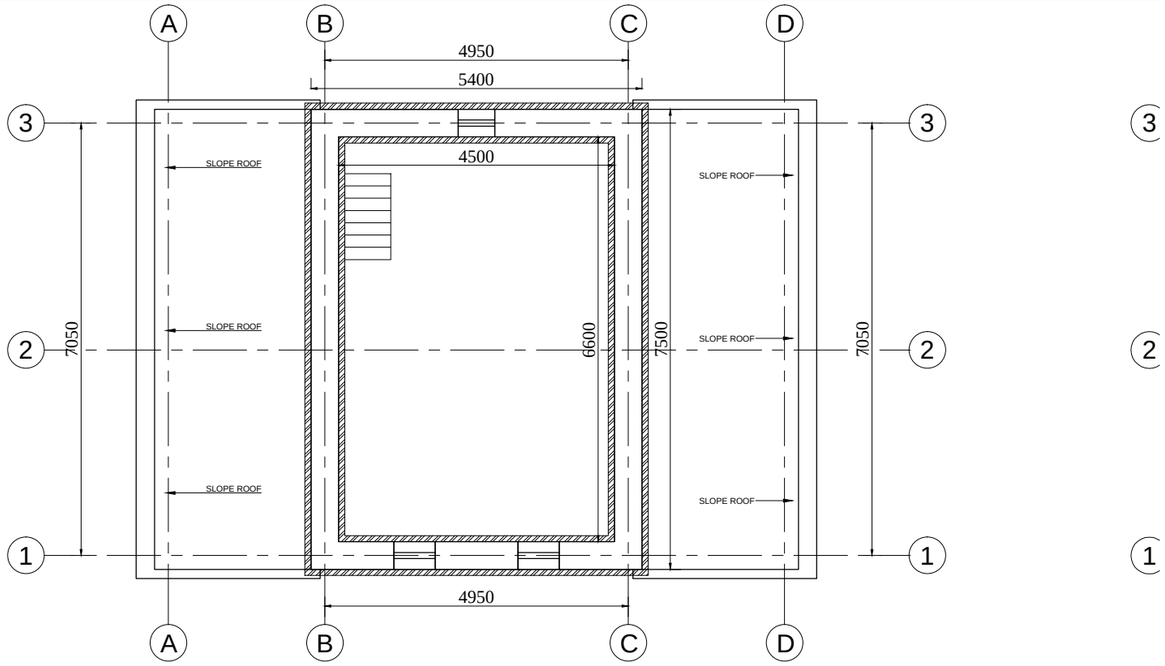
SHEET TITLE :-

DETAILS OF SPLINT AND JACKETING

SCALE :- 1:20, 1:10 FOR A3 PAPER

DATE :- JULY, 2017

08

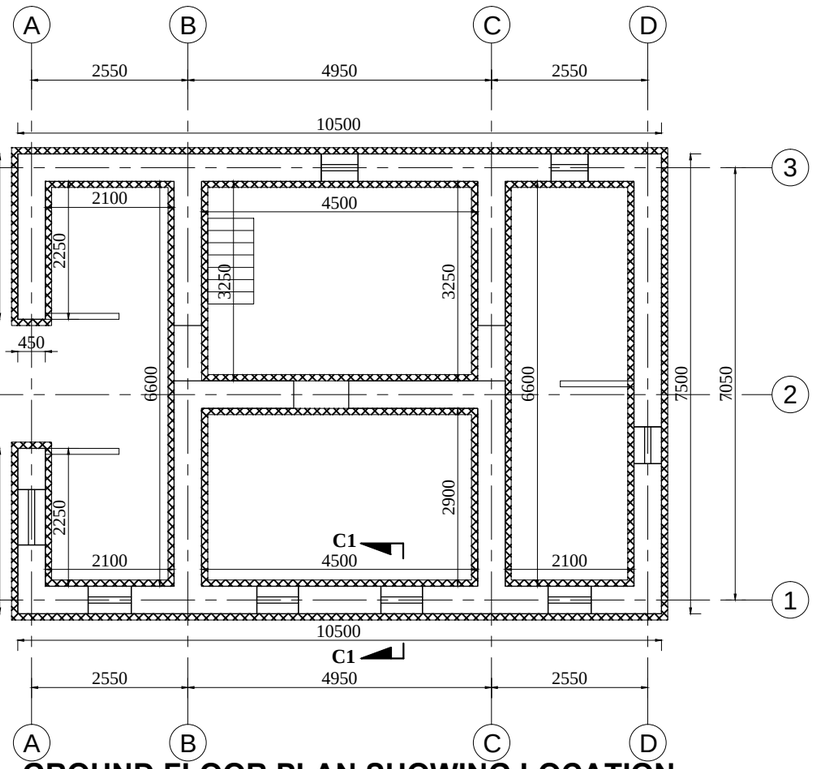


SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS

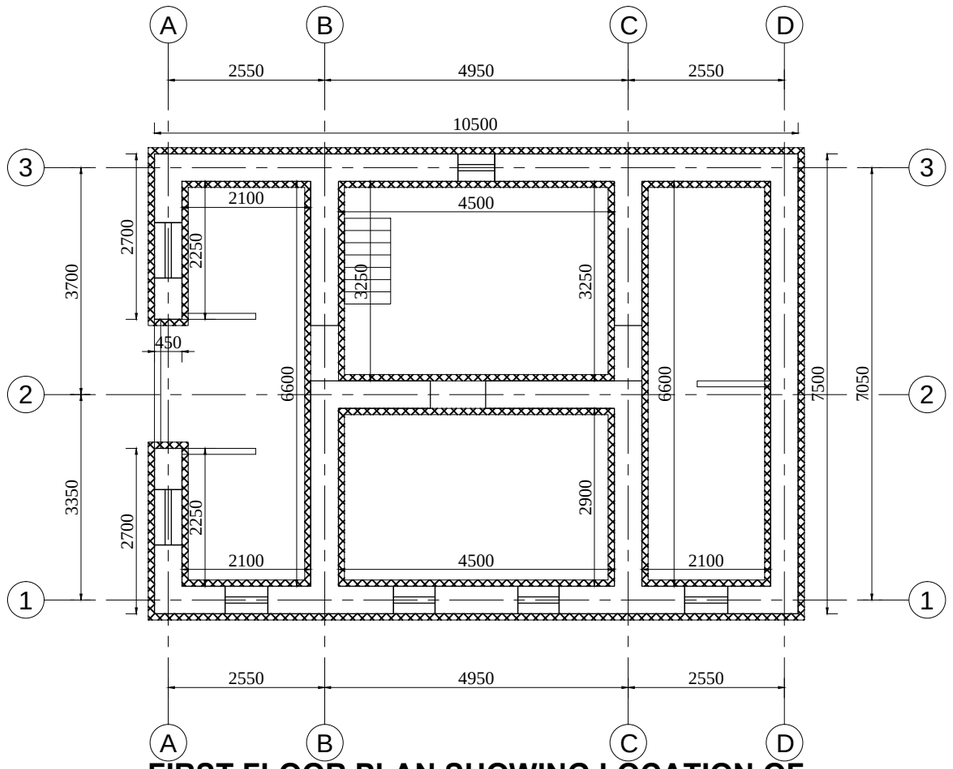
Notes:

Horizontal Bands with G.I. wire mesh of 12SWG (2.64mmØ)and size 25x25mm at Sill and Lintel level.

- A layer of cement slurry with bonding chemical (brick wall with plaster) shall be applied in wall after erecting wire mesh for horizontal bandage.
- Apply plaster of 20mm thick on internal wall over Galvanised wire mesh with cement sand mix (1:3)



GROUND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

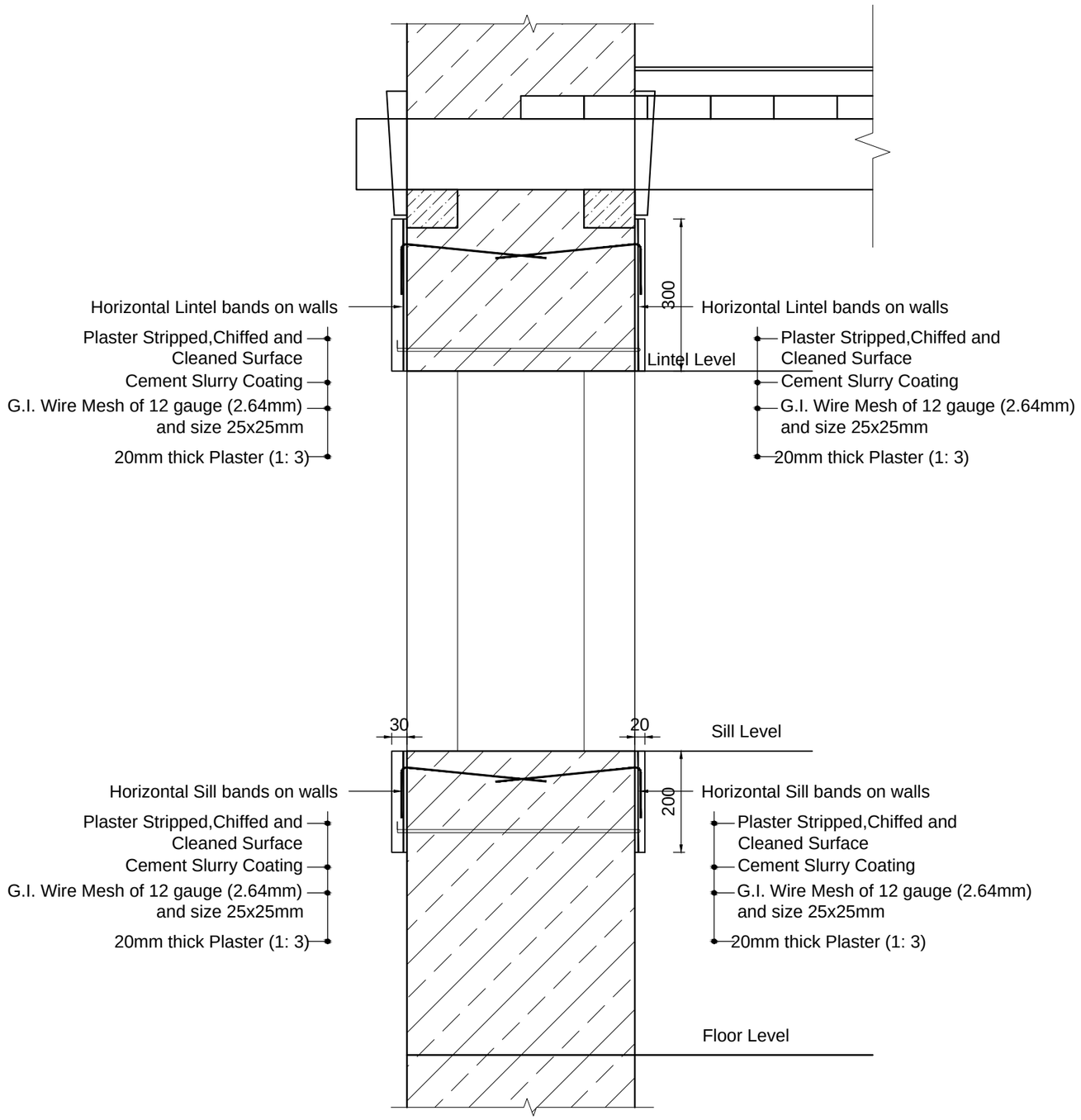
SHEET TITLE :-

FLOOR PLANS SHOWINGLOCATIONS OF HORIZONTAL BANDAGES AT FLOOR AND SILL LEVEL

09

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017



SECTION AT C1-C1

(DETAILS OF HORIZONTAL BANDAGES ON BOTH SURFACES OF WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

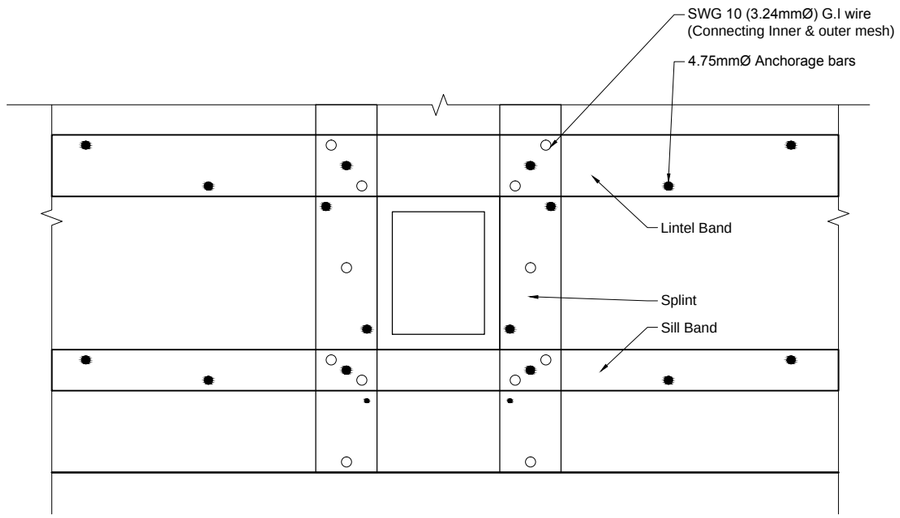
SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- 1:10 FOR A3 PAPER

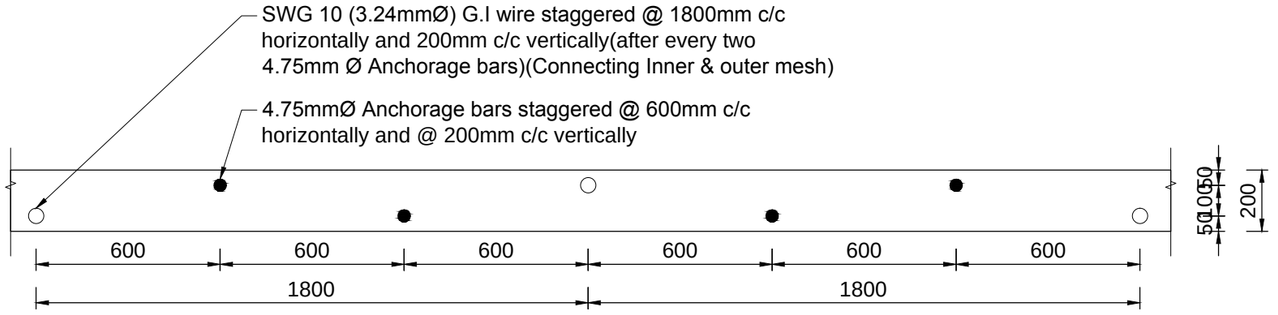
DATE :- JULY, 2017

10



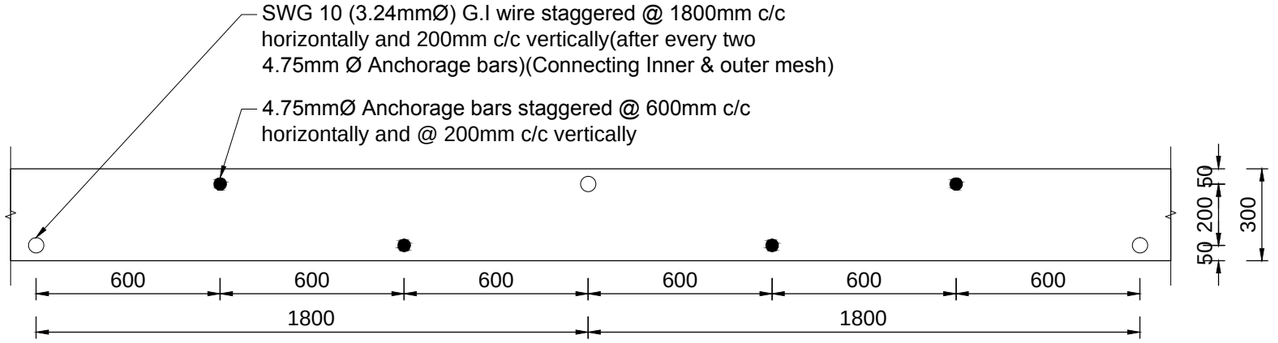
TYPICAL LAYOUT OF ANCHORAGE FOR CONNECTING SPLINT AND HORIZONTAL BANDAGE ON BOTH SIDES OF WALLS

SCALE 1:30



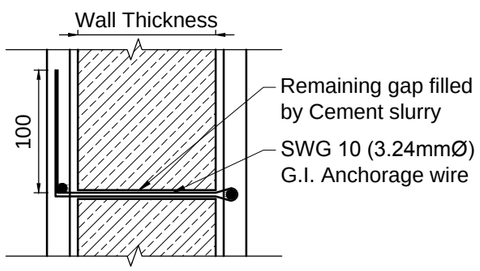
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT SILL LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



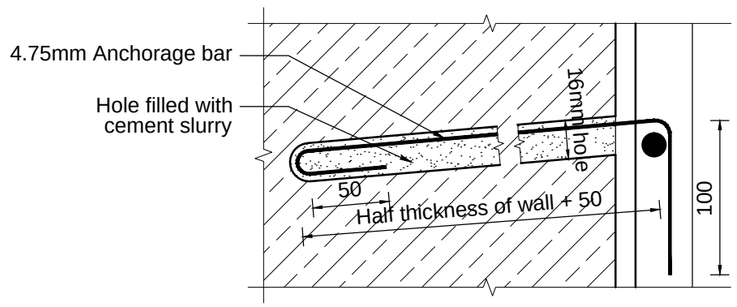
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT LINTEL LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



G.I. WIRE DETAILS

SCALE 1:10



ANCHORAGE BAR DETAILS

SCALE 1:4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

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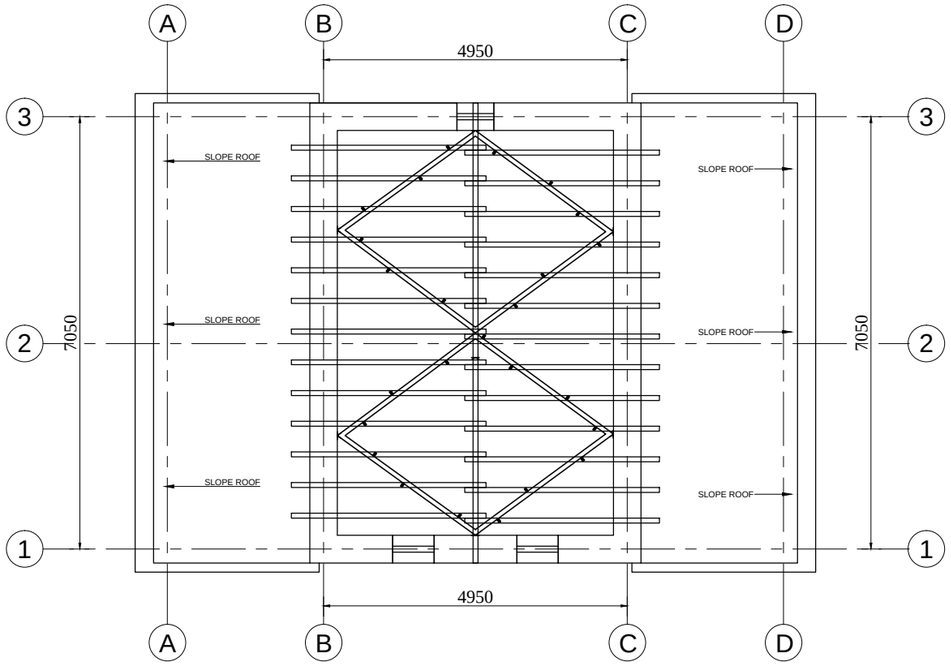
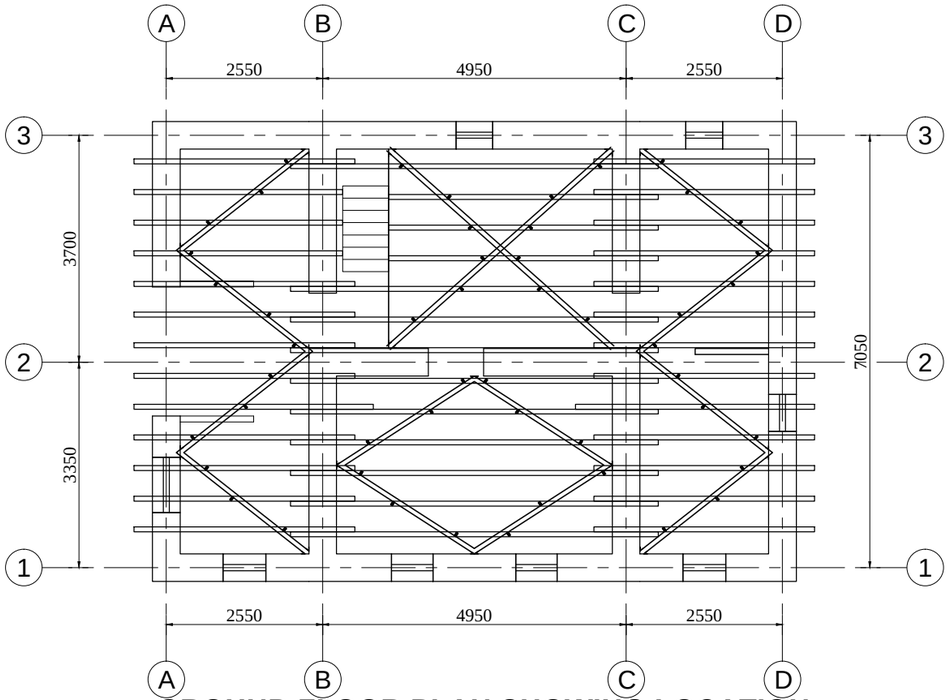
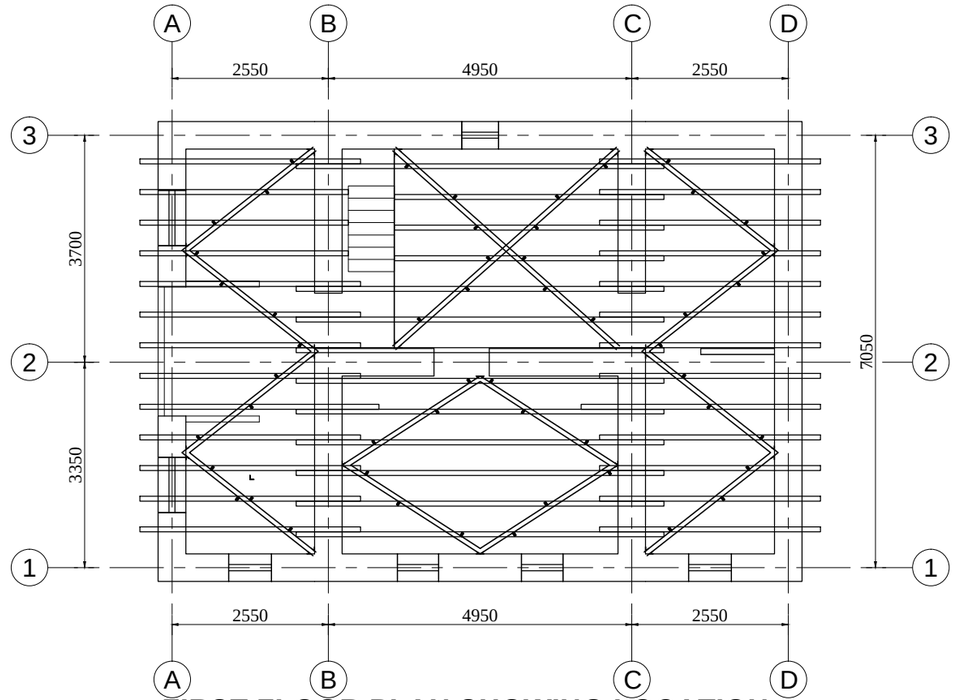


SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



GROUND FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF



FIRST FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

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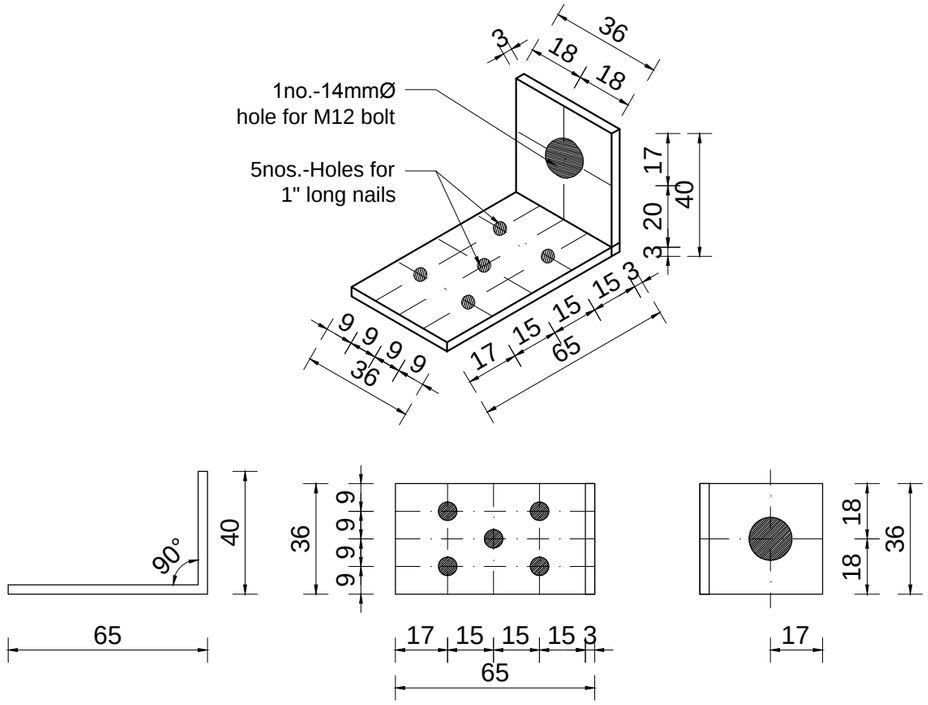
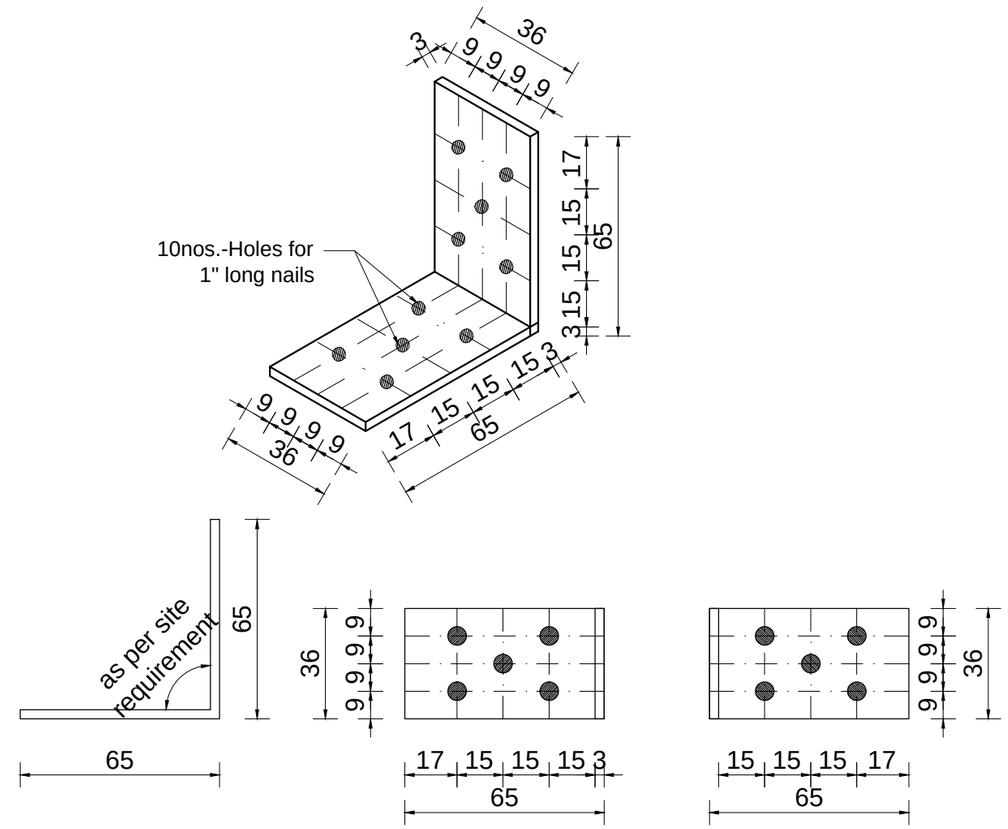


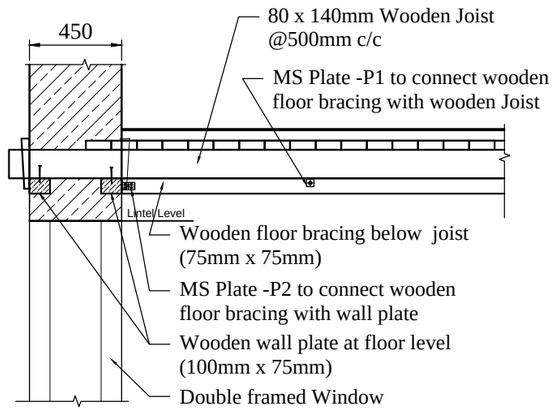
MS PLATE - P1

SCALE 1:2



MS PLATE - P2

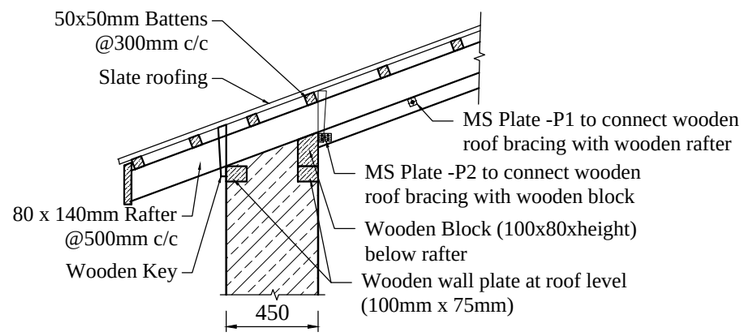
SCALE 1:2



DETAIL A1

SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL

SCALE = 1:30



DETAIL B1

SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL

SCALE = 1:30

PROJECT TITLE :-

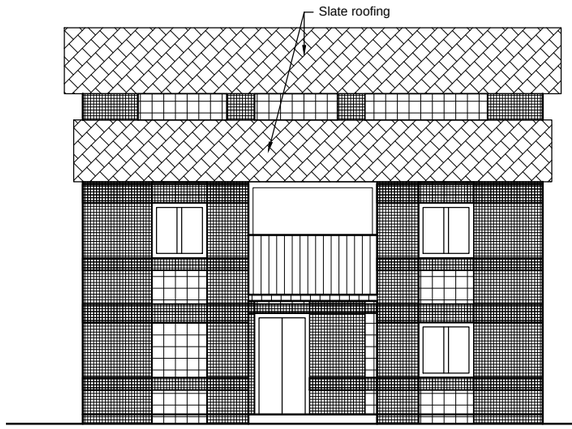
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

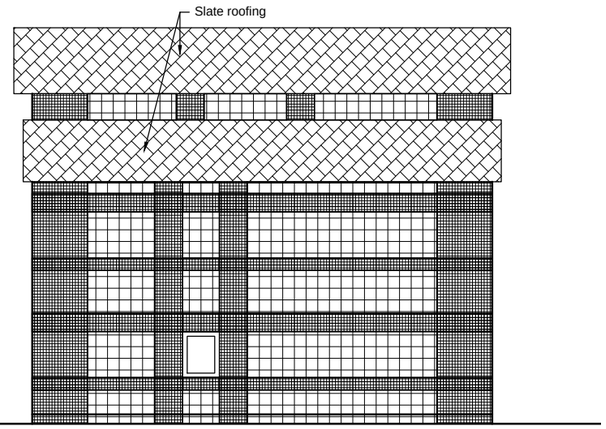
13

SCALE :- 1:30, 1:2 FOR A3 PAPER

DATE :- JULY, 2017

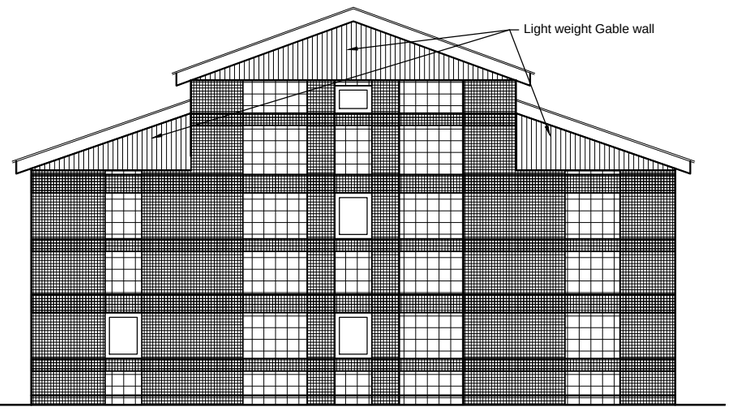


ELEVATION-1



ELEVATION-3

ELEVATION-2



ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING G.I. WIRE MESHING

SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING AFTER RETROFIT

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

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STRUCTURAL DRAWINGS FOR RETROFIT DESIGN ON TWO STOREY STONE MASONRY BUILDING IN MUD USING G.I. WIREMESH AND PP BANDS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

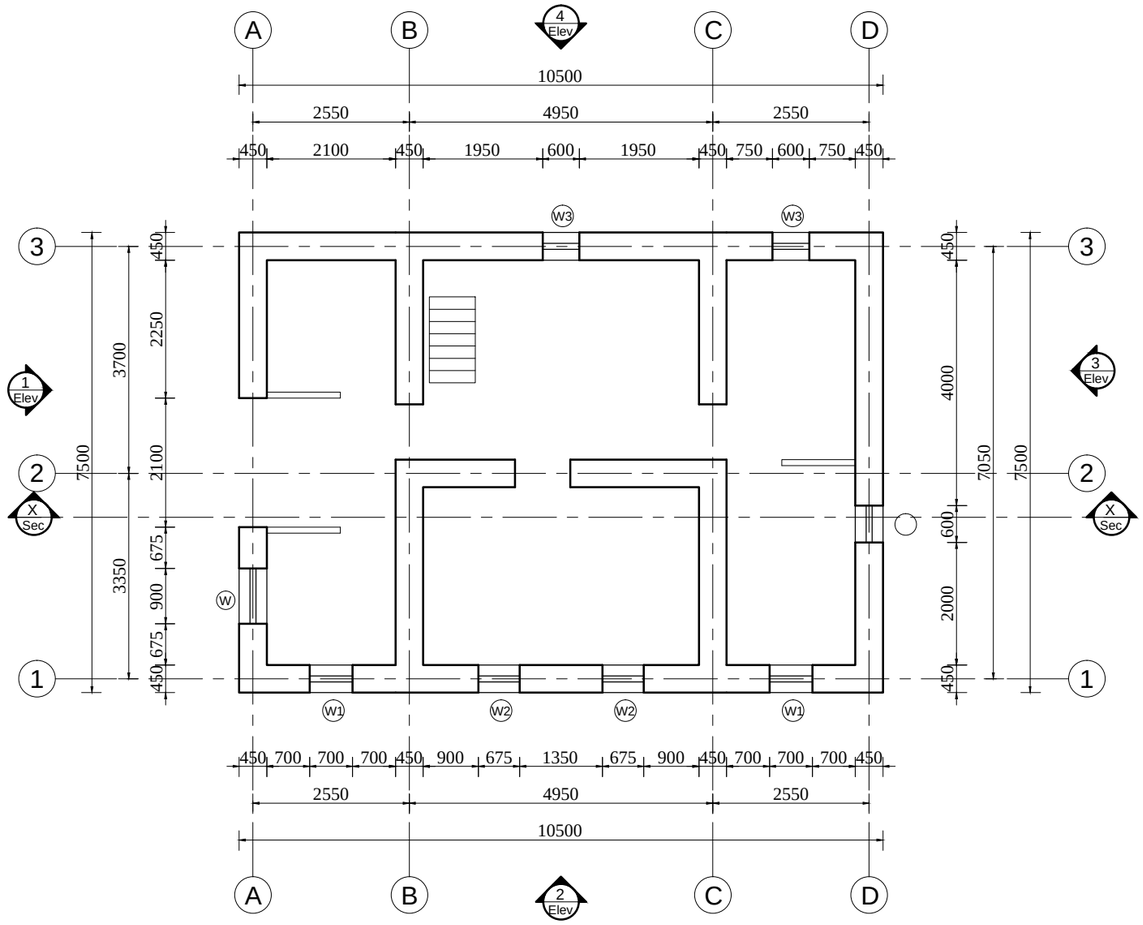
SHEET TITLE :-

COVER PAGE

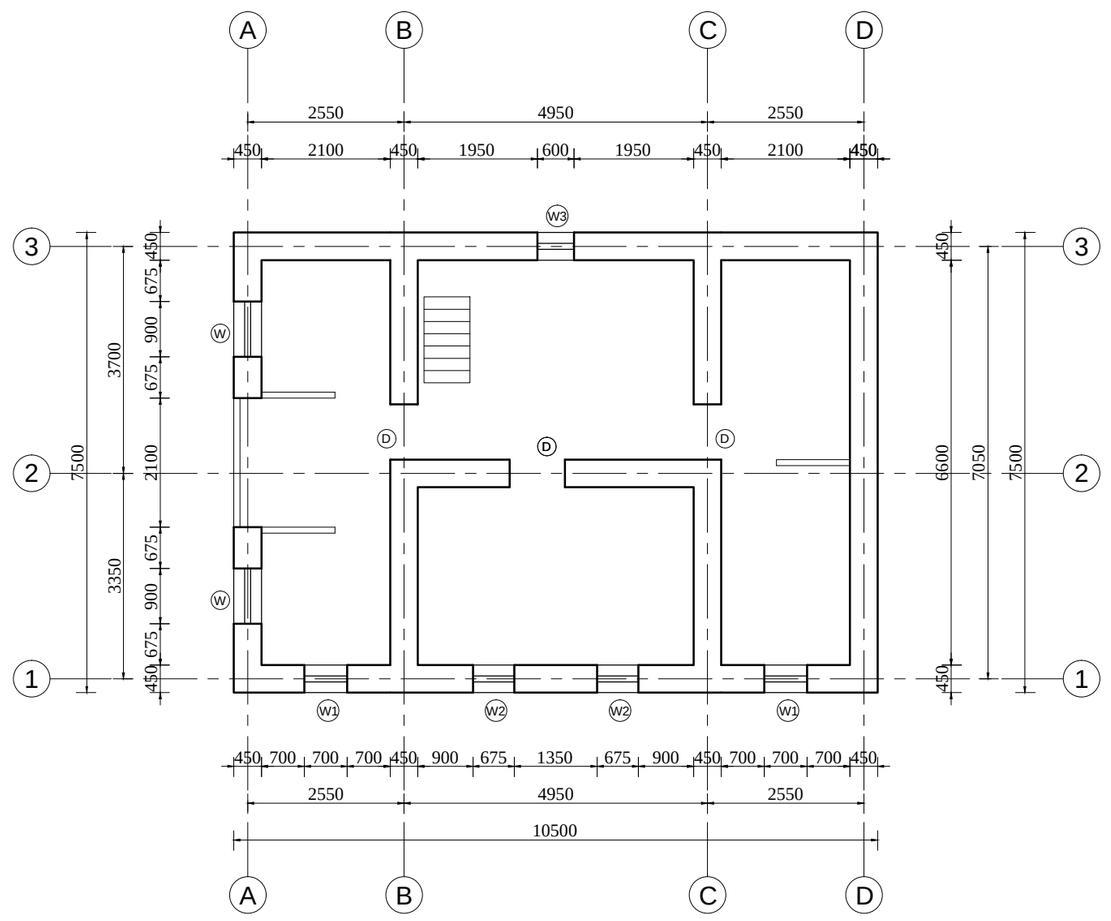
0

SCALE :- N/A

DATE :- JULY, 2017



GROUND FLOOR PLAN



FIRST FLOOR PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

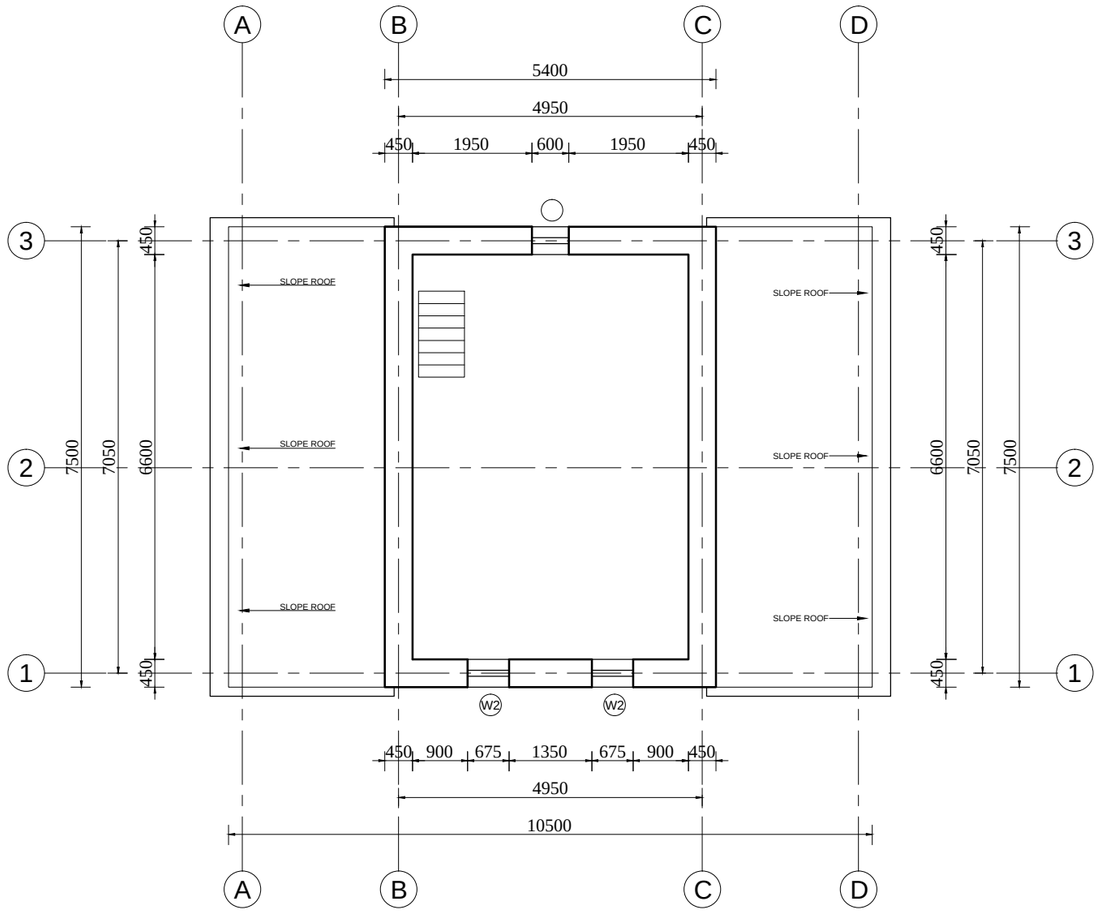
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

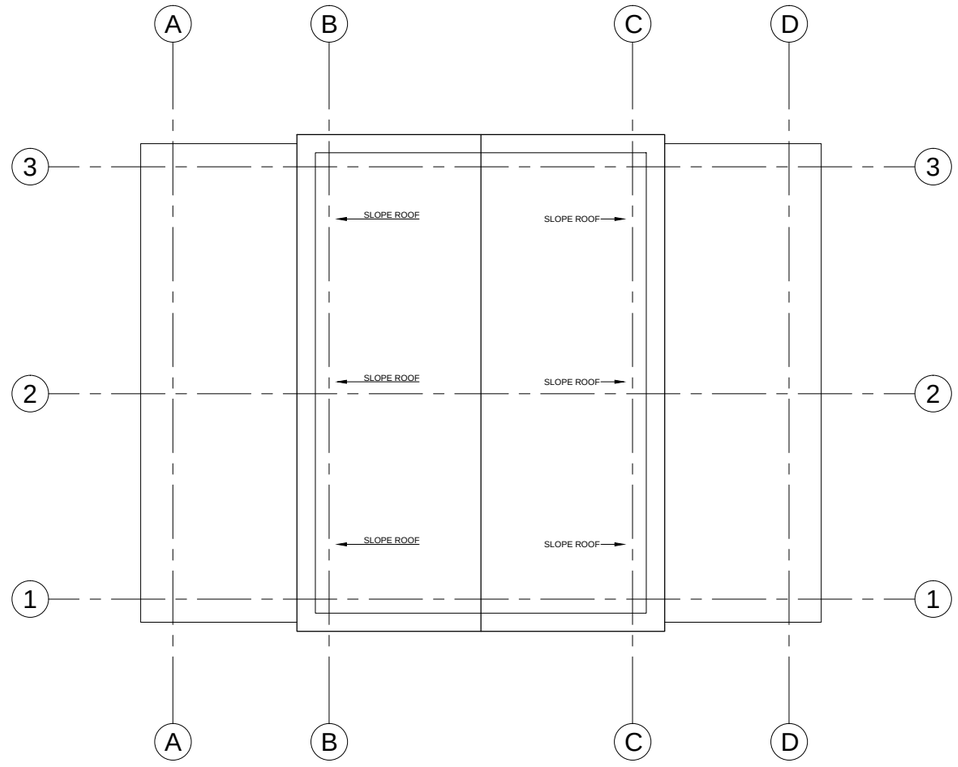
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

01



SECOND FLOOR PLAN



ROOF PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

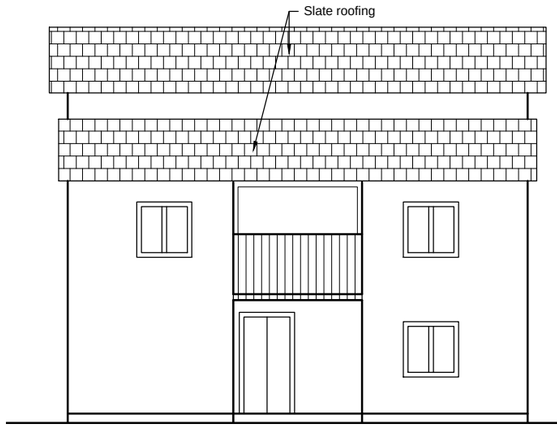
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

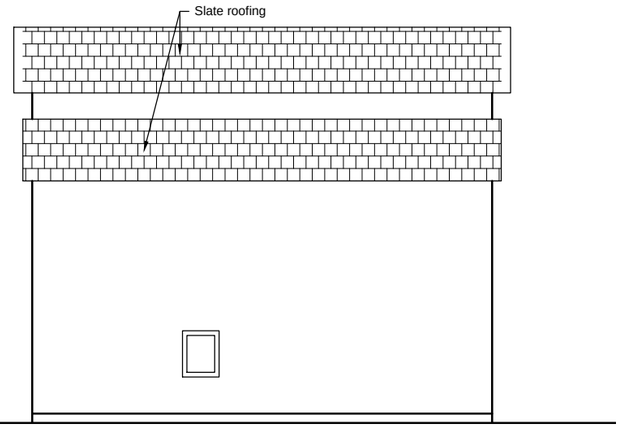
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

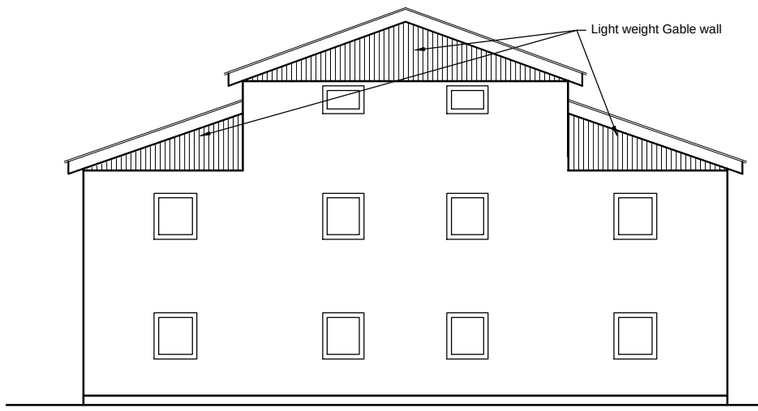
02



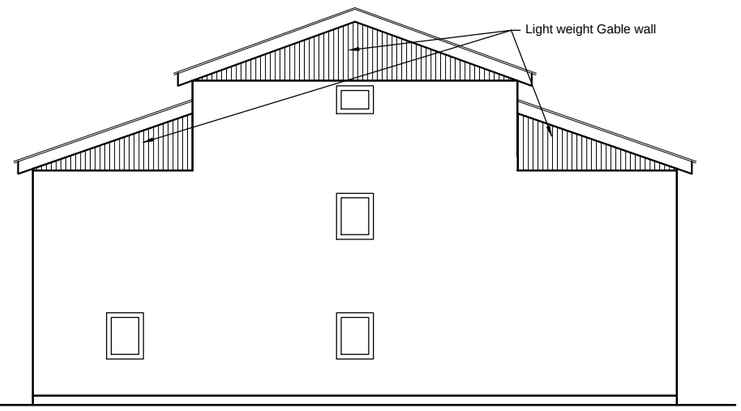
ELEVATION-1



ELEVATION-3



ELEVATION-2



ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

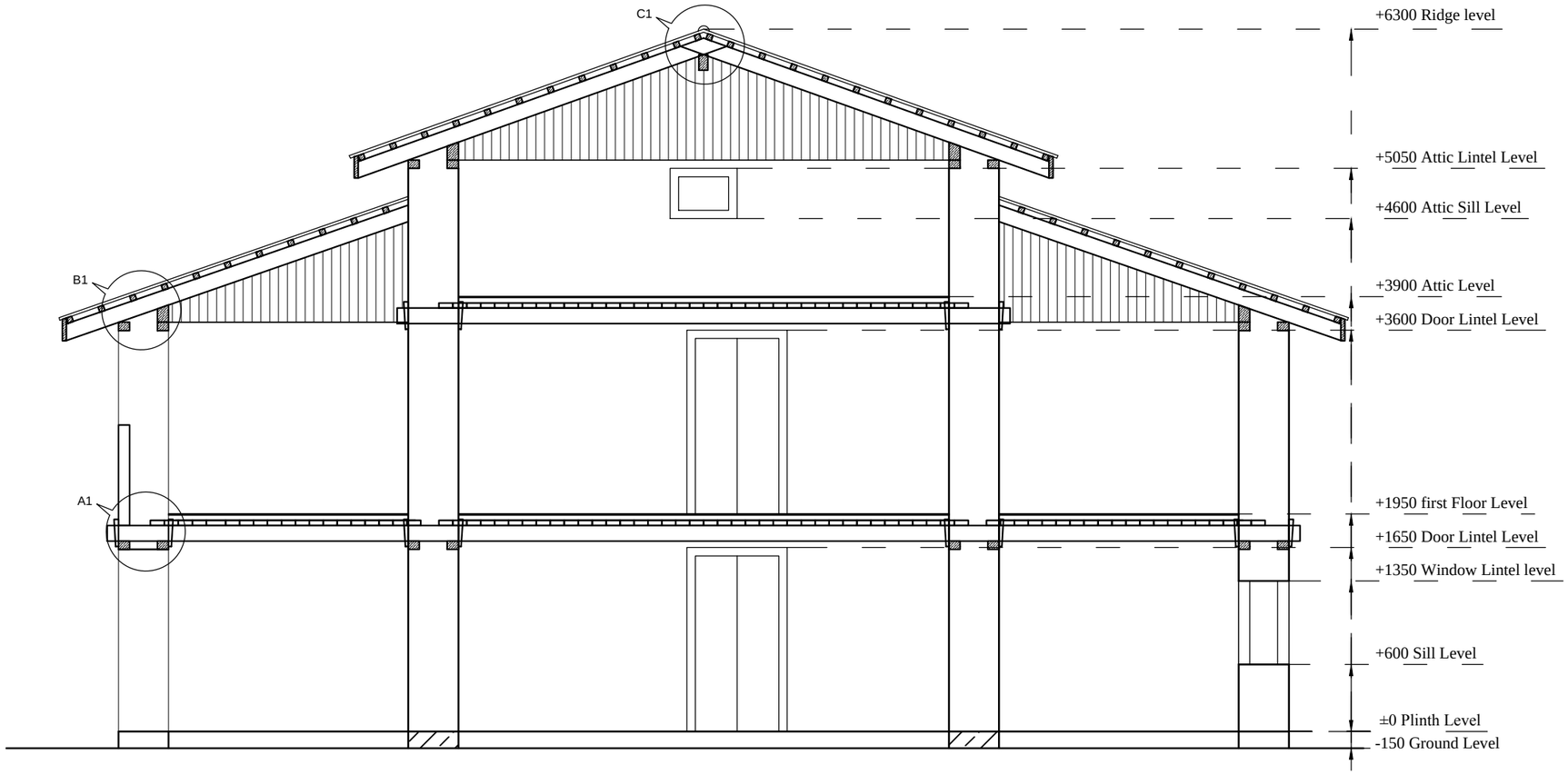
SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING

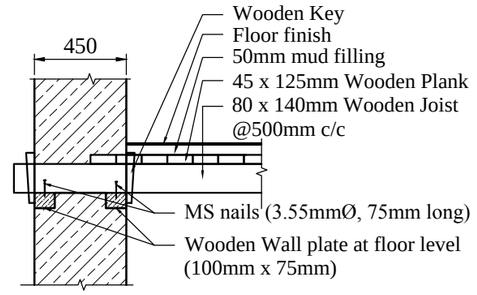
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

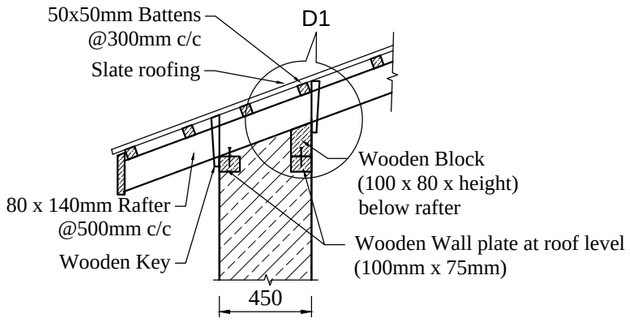
03



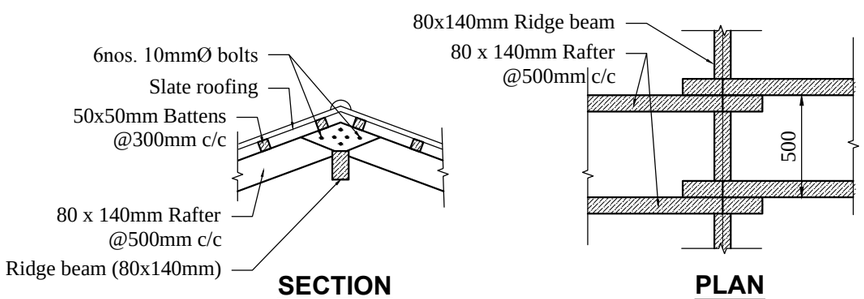
SECTION AT X-X
SCALE = 1:50



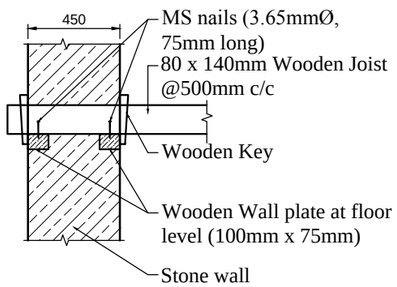
DETAIL A1
SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL
SCALE = 1:30



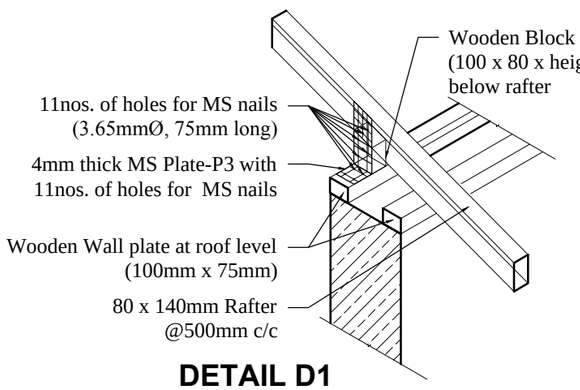
DETAIL B1
SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL
SCALE = 1:30



DETAIL C1
SHOWING ROOF DETAILS AT RIDGE LEVEL
SCALE = 1:30



FIXING OF JOISTS
SCALE = 1:30



DETAIL D1
SHOWING CONNECTION OF RAFTER WITH ROOF BAND
SCALE = 1:30

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

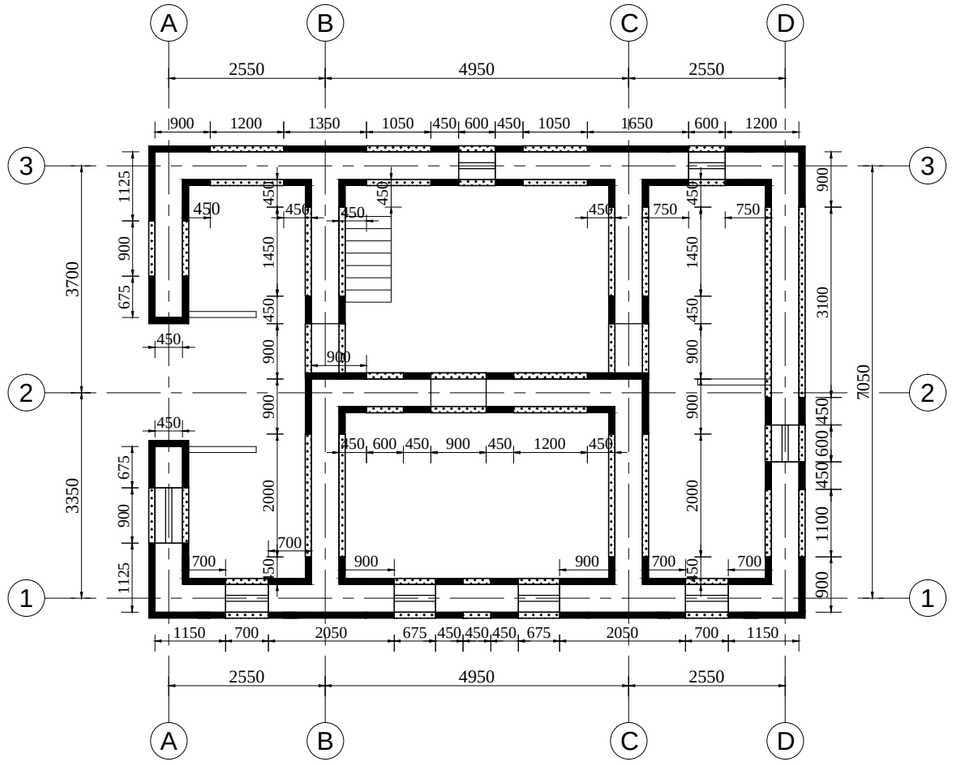
SHEET TITLE :-

SECTION OF EXISTING BUILDING AND DETAILS

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

04

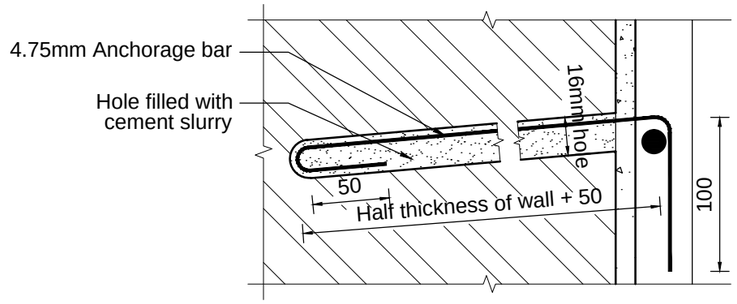


GROUND FLOOR PLAN SHOWING TIE BEAM FOR SPLINT AND JACKETING

SCALE = 1:100

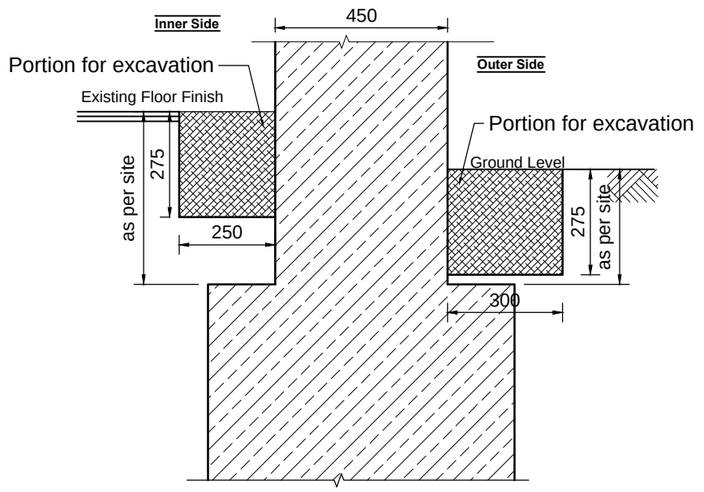
Notes:

- Tie beam for Splint of 450mm width on walls using G.I. welded wiremesh of 14SWG (2.03mm Ø) and size 25x25mm.
- Tie beam for Jacketing on remaining walls using 10mm wide PP band @ 100mm c/c both horizontally and vertically



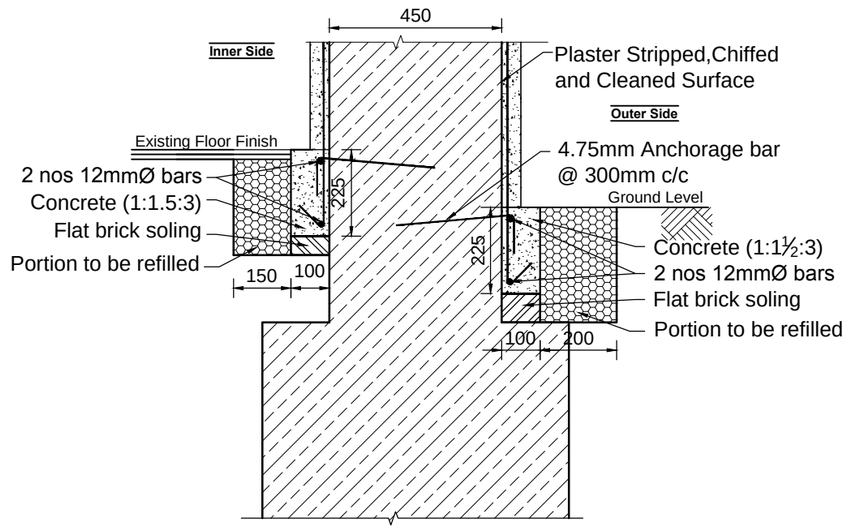
4.75 MM ANCHORAGE BAR DETAILS

SCALE 1:4



SECTION SHOWING THE PORTION TO BE EXCAVATED FOR TIE BEAM

SCALE = 1:16



DETAILS OF TIE BEAM FOR INNER AND OUTER SIDE OF THE WALL

SCALE = 1:16

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

SHEET TITLE :-

TIE BEAM AND DETAILS

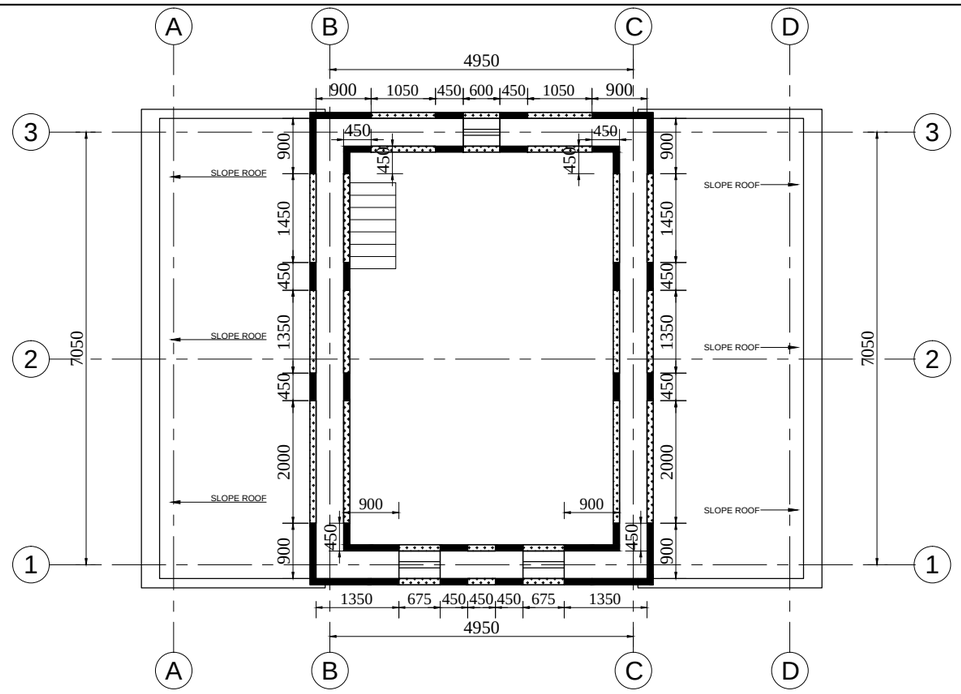
SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

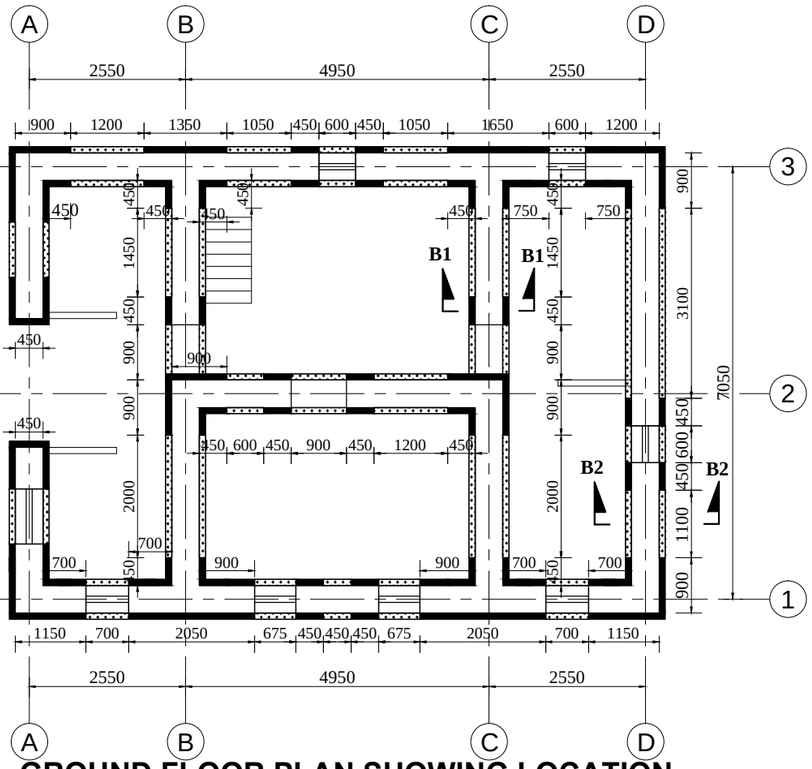
05

Notes:

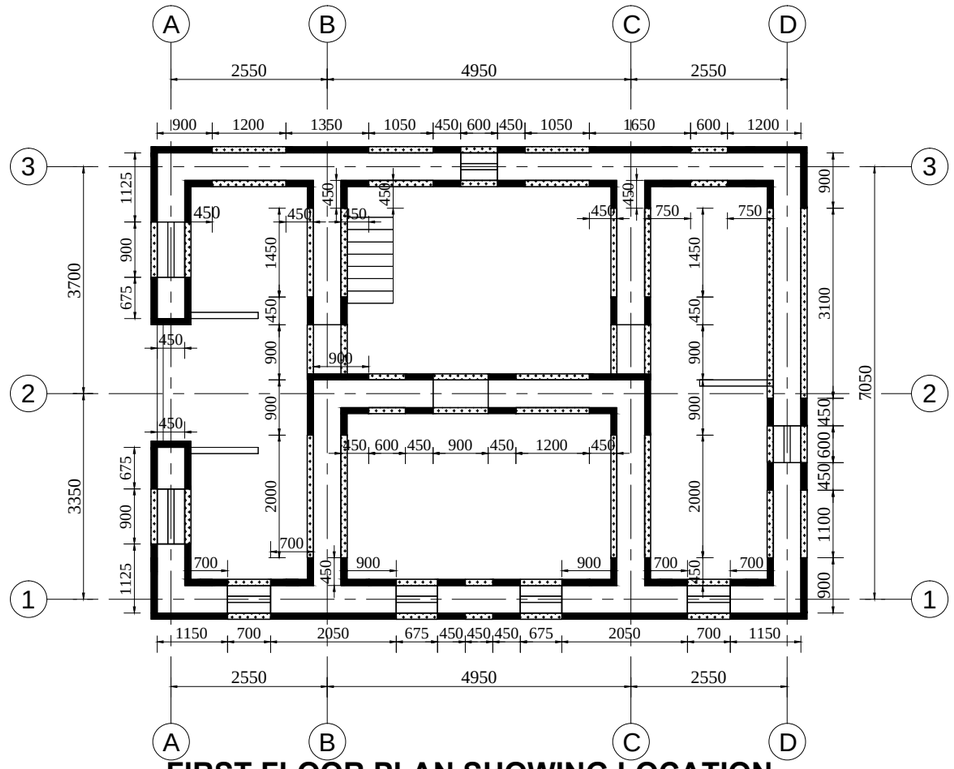
- Splint of 450mm width on walls using G.I. welded wiremesh of 14SWG (2.03mm Ø) and size 25x25mm.
- Jacketing on remaining walls using 10mm wide PP band @ 100mm c/c both horizontally and vertically



SECOND FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

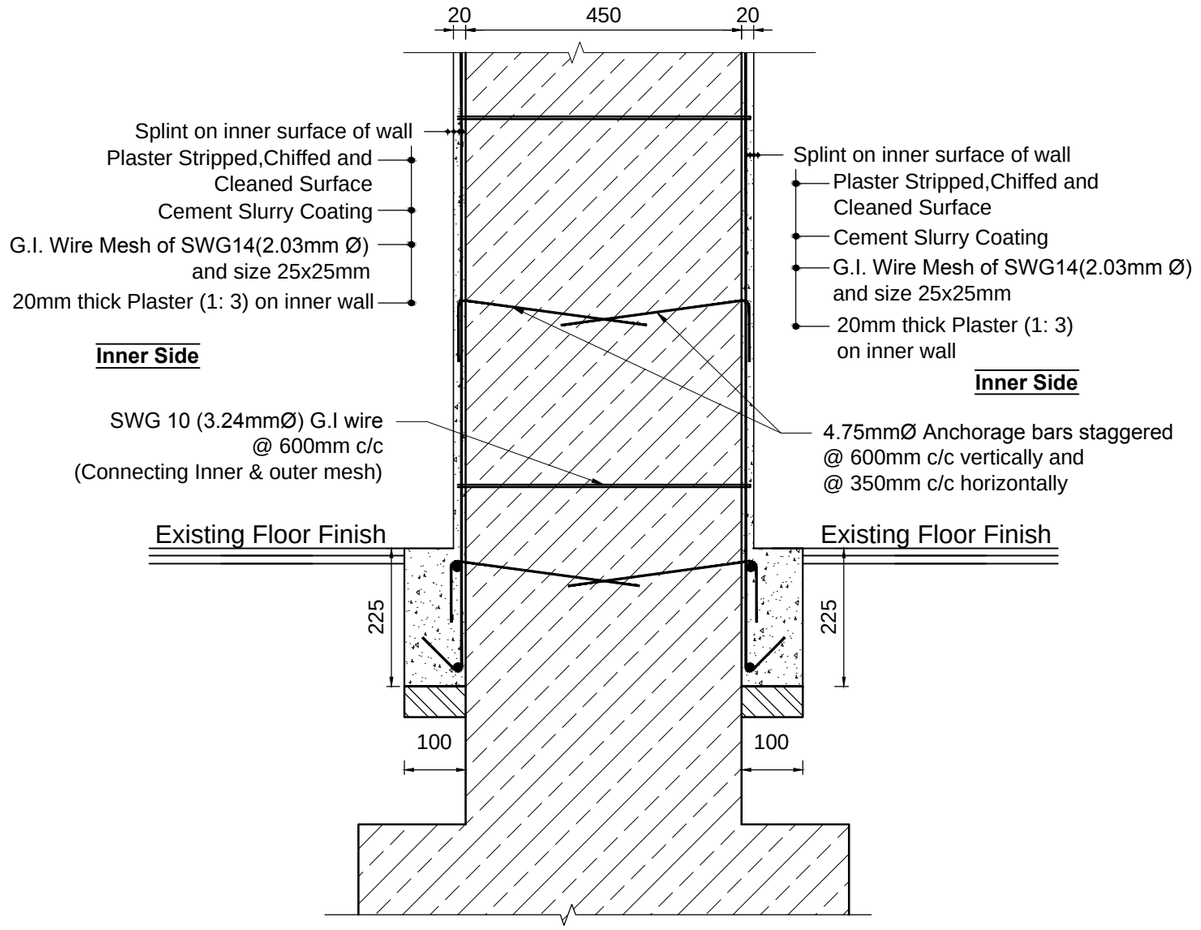


GROUND FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS

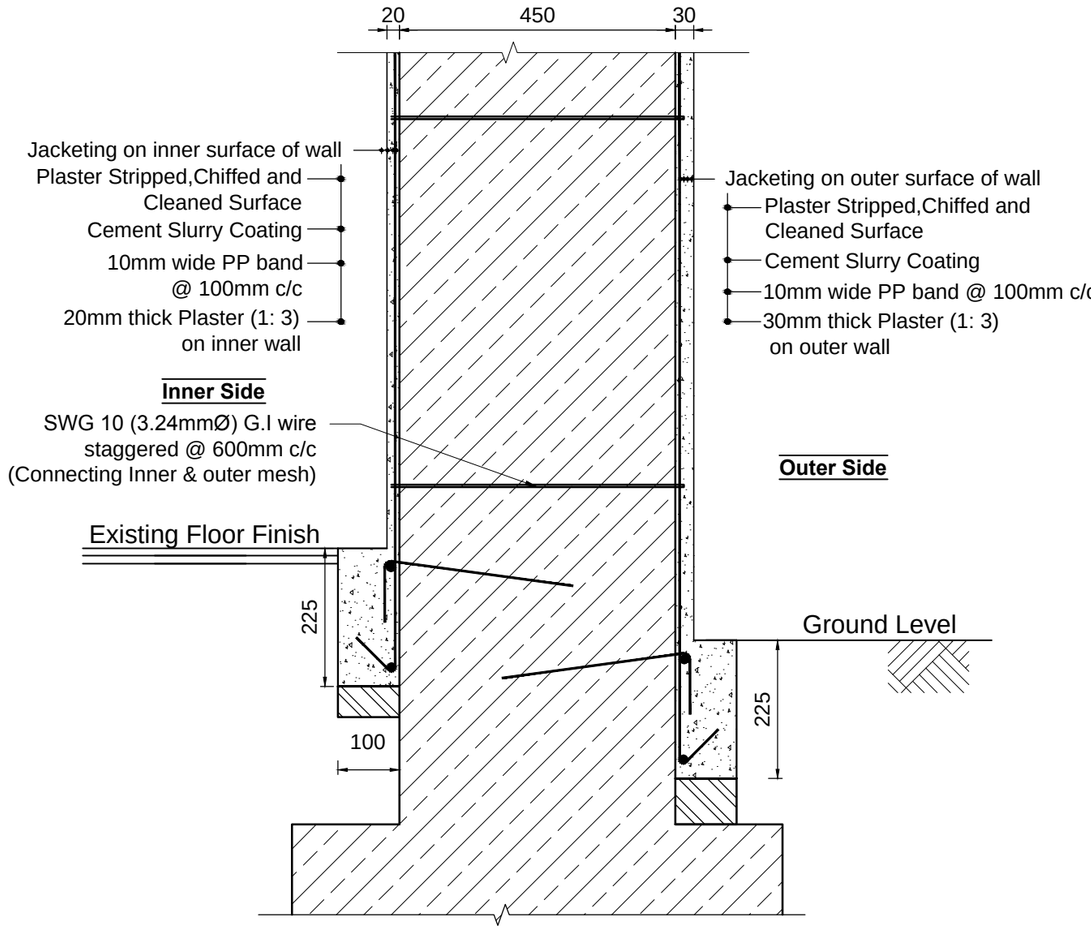
PROJECT TITLE :- STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND	SHEET TITLE :- FLOOR PLANS SHOWING LOCATION OF SPLINT AND JACKETING ON WALLS
	SCALE :- 1:100 FOR A3 PAPER / DATE :- JULY, 2017
	06



SECTION AT B1-B1

(DETAILS OF SPLINT ON BOTH SURFACES OF INTERNAL WALLS)

SCALE = 1:10



SECTION AT B2-B2

(DETAILS OF JACKETING ON BOTH SURFACES OF PERIPHERAL WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

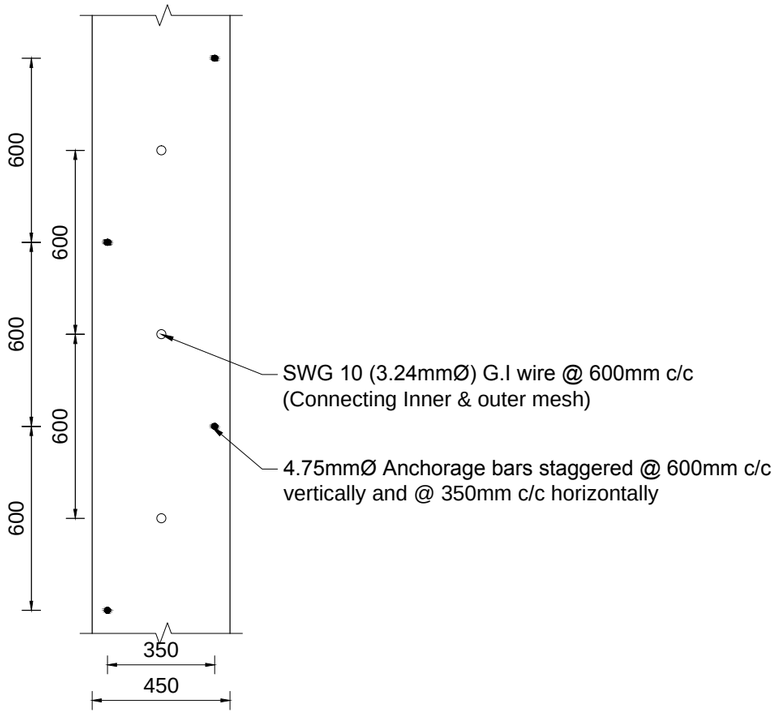
SHEET TITLE :-

DETAILS OF SPLINT AND JACKETING

SCALE :- 1:10 FOR A3 PAPER

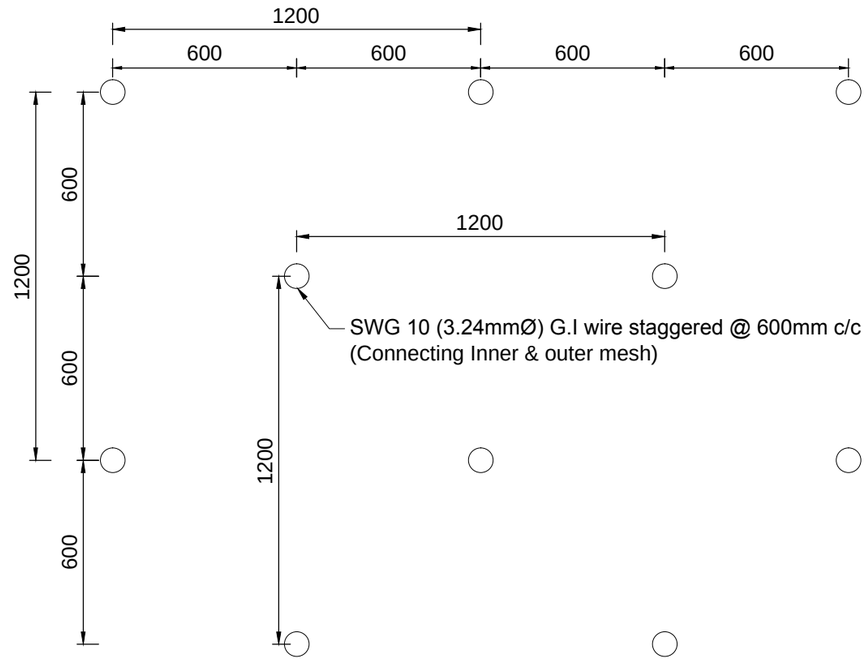
DATE :- JULY, 2017

07



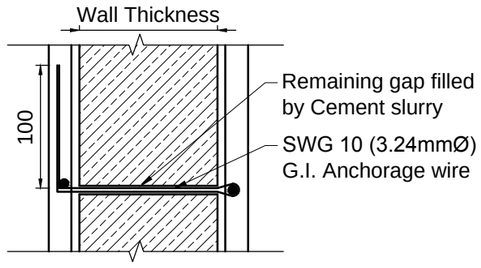
LAYOUT OF ANCHORAGE BARS FOR CONNECTING SPLINT BANDS ON BOTH SIDES OF WALLS

SCALE 1:20



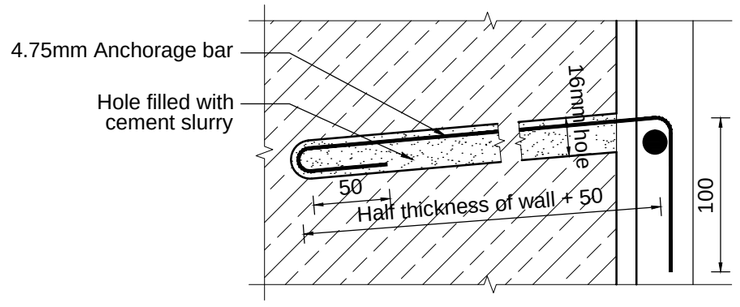
LAYOUT OF G.I. WIRE ANCHORAGE FOR CONNECTING JACKETING MESH ON BOTH SIDES OF WALL

SCALE 1:20



G.I. WIRE DETAILS

SCALE 1:10



ANCHORAGE BAR DETAILS

SCALE 1:4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

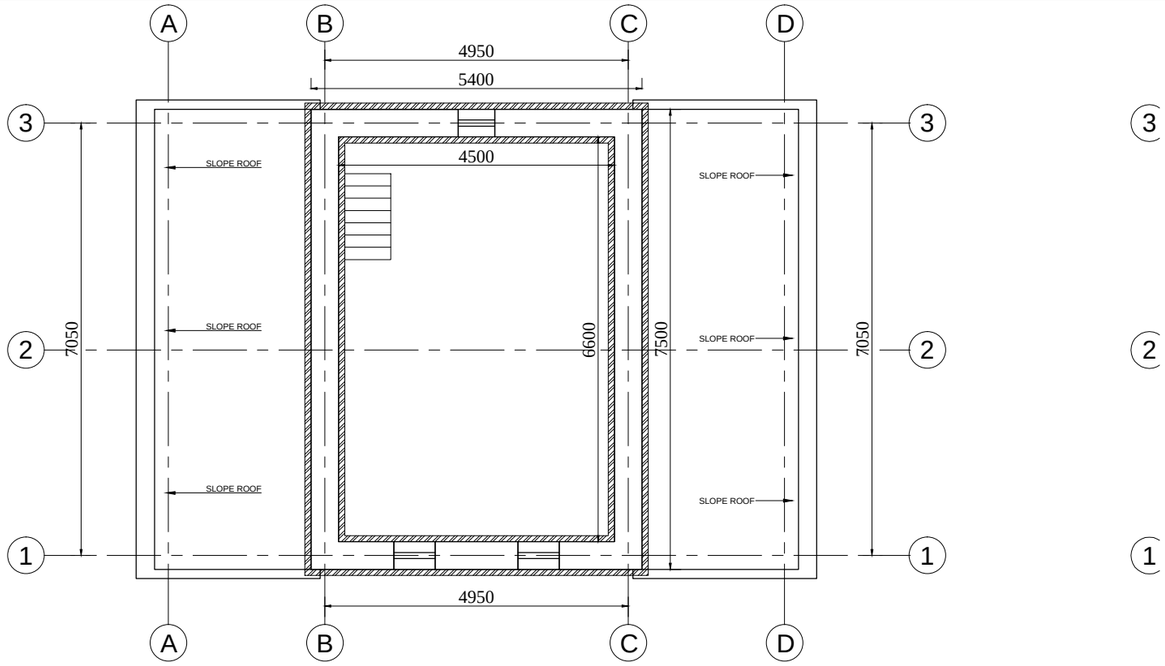
SHEET TITLE :-

DETAILS OF SPLINT AND JACKETING

SCALE :- 1:20, 1:10 FOR A3 PAPER

DATE :- JULY, 2017

08

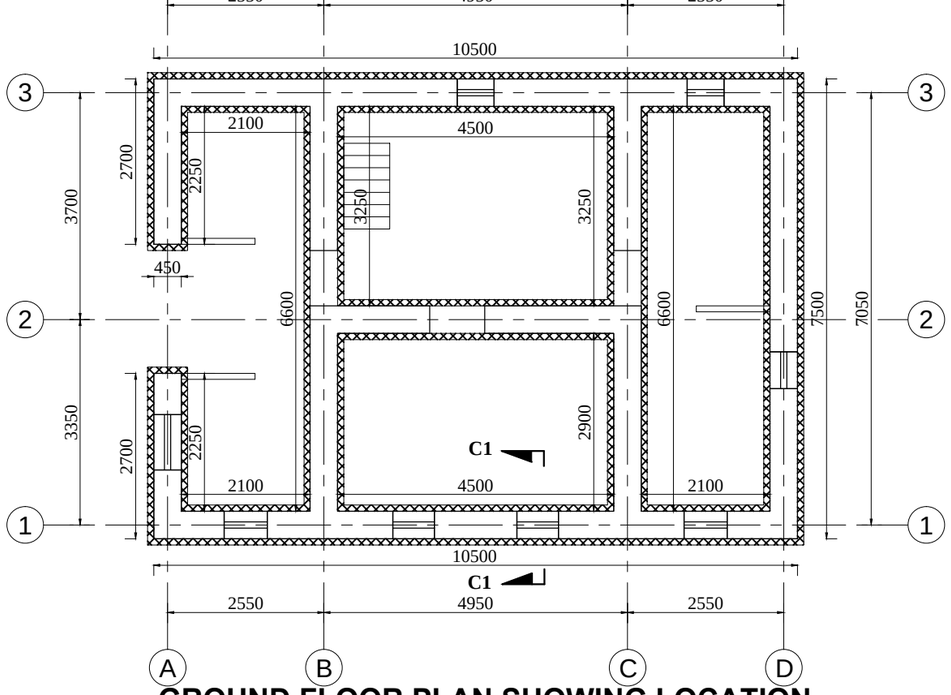


SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS

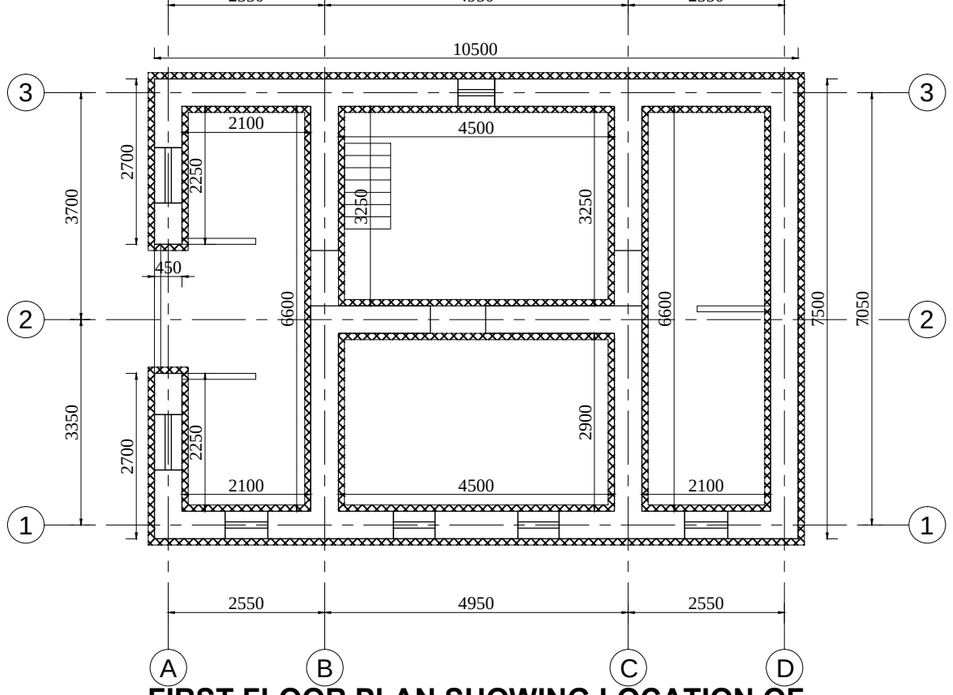
Notes:

Horizontal Bands with G.I. wire mesh of 12SWG (2.64mmØ) and size 25x25mm at Sill and Lintel level.

- A layer of cement slurry with bonding chemical (brick wall with plaster) shall be applied in wall after erecting wire mesh for horizontal bandage.
- Apply plaster of 20mm thick on internal wall over Galvanised wire mesh with cement sand mix (1:3)



GROUND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

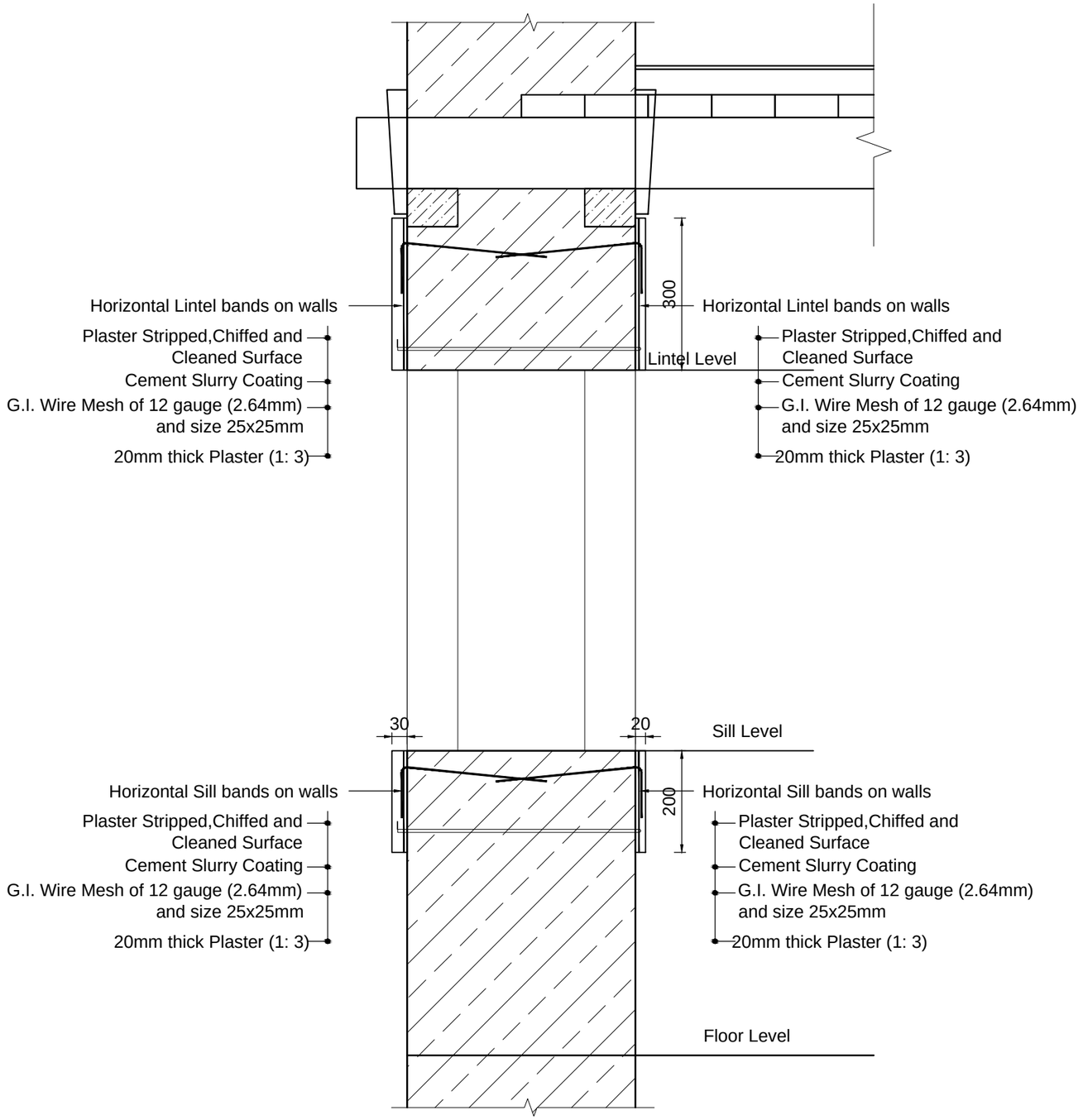
SHEET TITLE :-

FLOOR PLANS SHOWINGLOCATIONS OF HORIZONTAL BANDAGES AT FLOOR AND SILL LEVEL

09

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017



SECTION AT C1-C1

(DETAILS OF HORIZONTAL BANDAGES ON BOTH SURFACES OF WALLS)

SCALE = 1:10

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

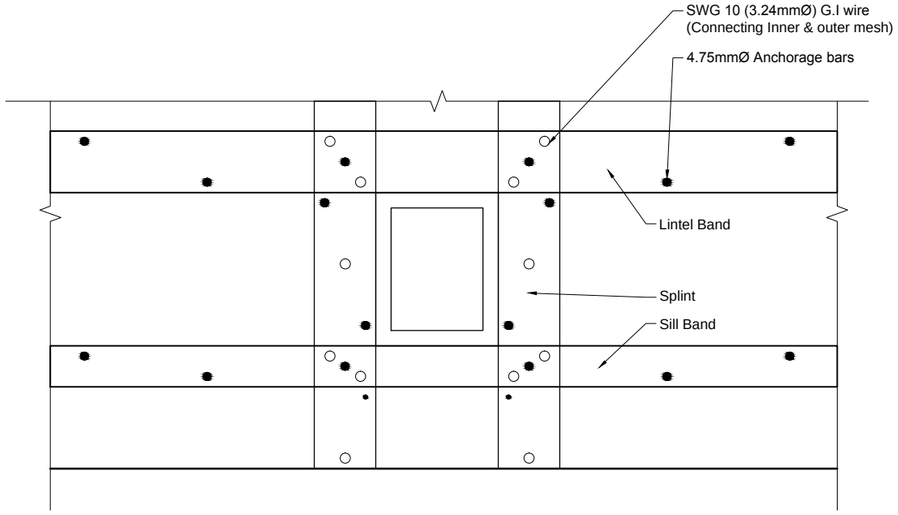
SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- 1:10 FOR A3 PAPER

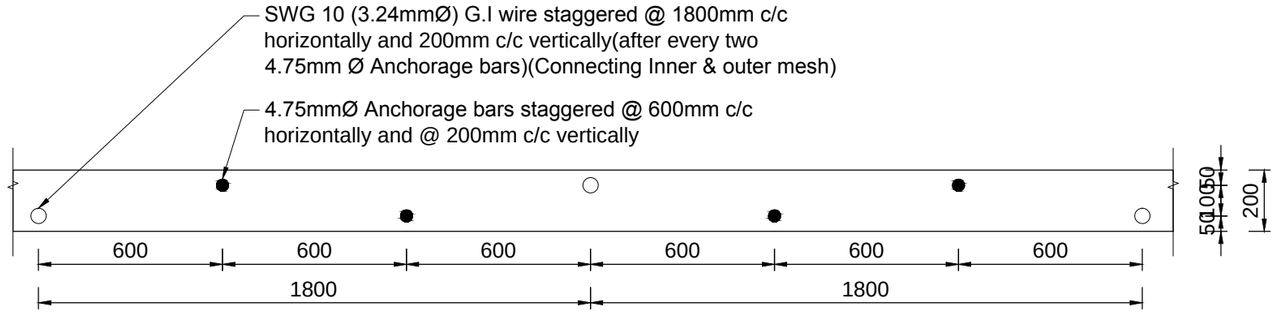
DATE :- JULY, 2017

10



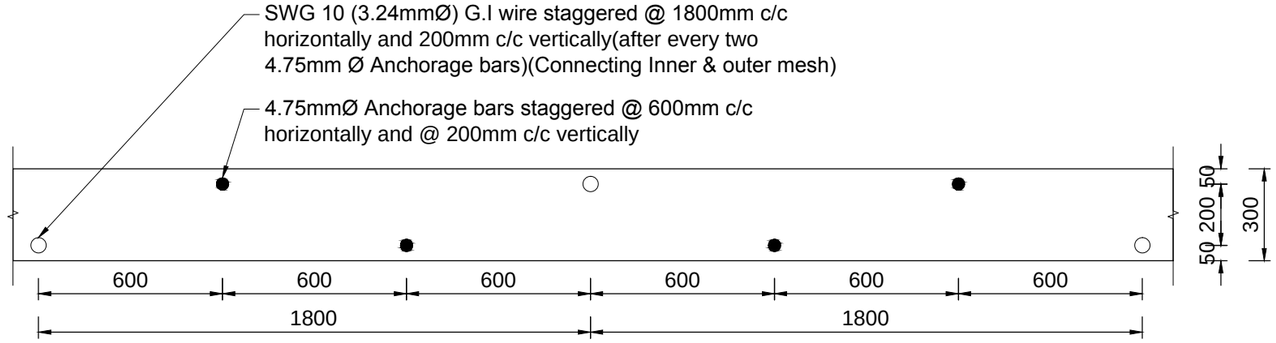
TYPICAL LAYOUT OF ANCHORAGE FOR CONNECTING SPLINT AND HORIZONTAL BANDAGE ON BOTH SIDES OF WALLS

SCALE 1:30



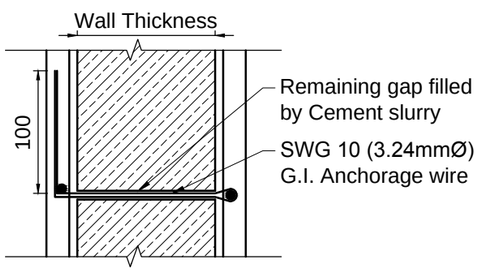
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT SILL LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



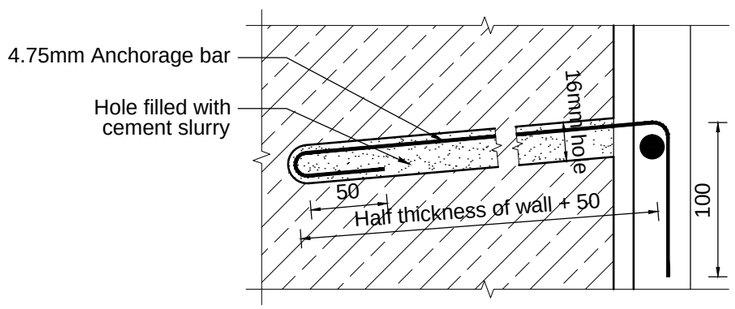
LAYOUT OF ANCHORAGE BARS FOR CONNECTING HORIZONTAL BANDAGES AT FLOOR LEVEL ON BOTH SIDES OF WALL

SCALE = 1:20



G.I. WIRE DETAILS

SCALE 1:10



ANCHORAGE BAR DETAILS

SCALE 1:4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

SHEET TITLE :-

DETAILS OF HORIZONTAL BANDAGES

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

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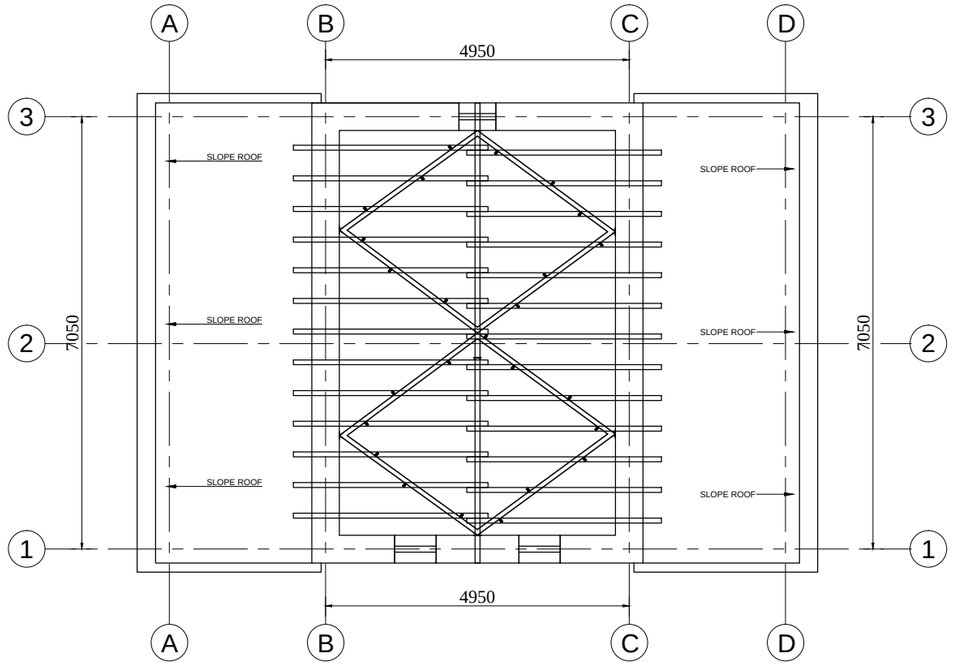
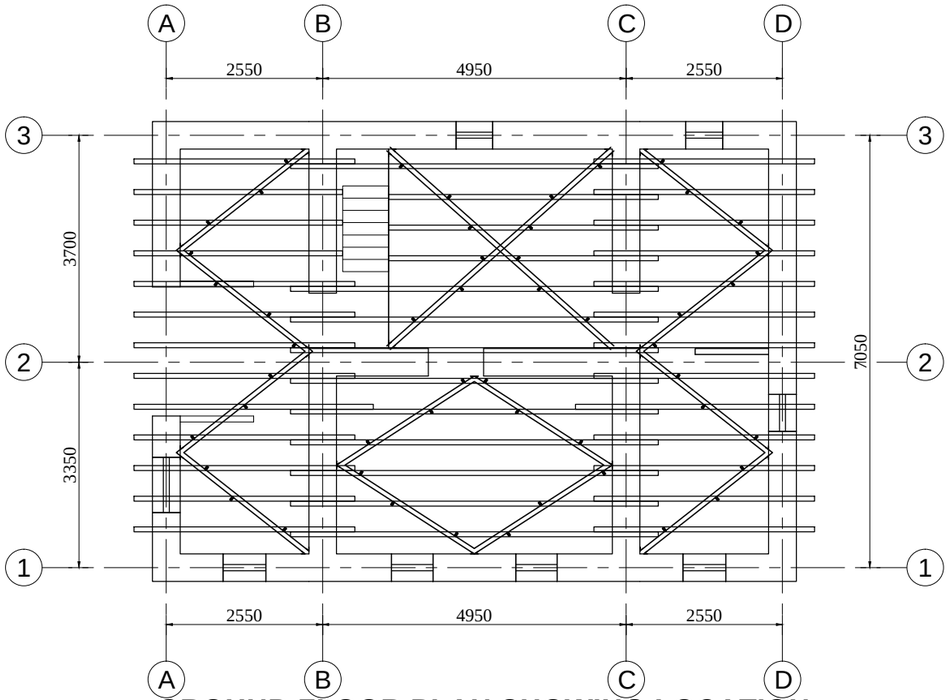
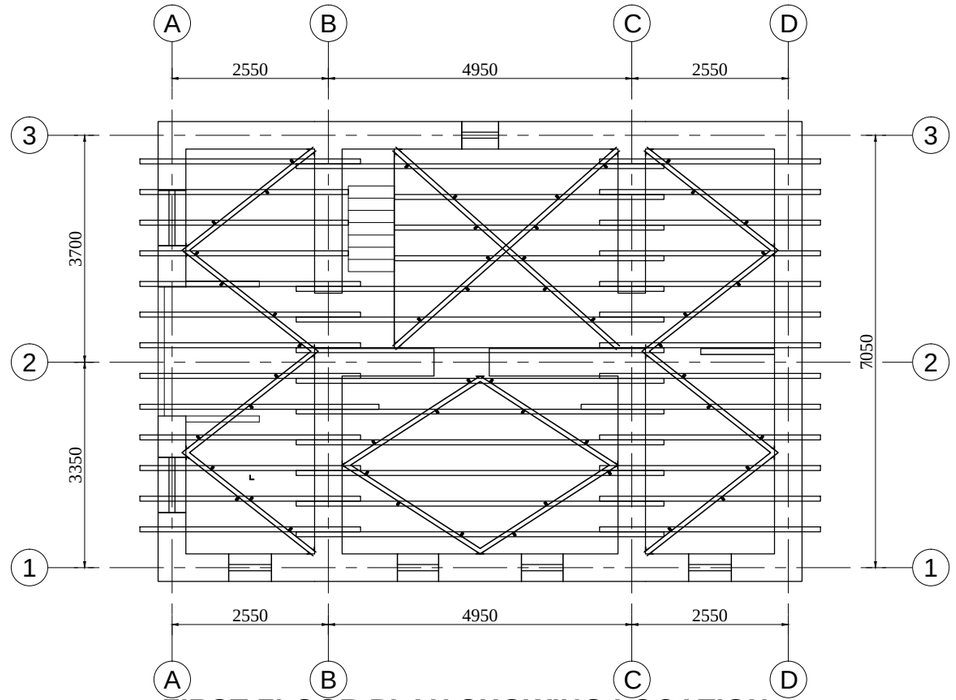


SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



GROUND FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF



FIRST FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF

PROJECT TITLE :-

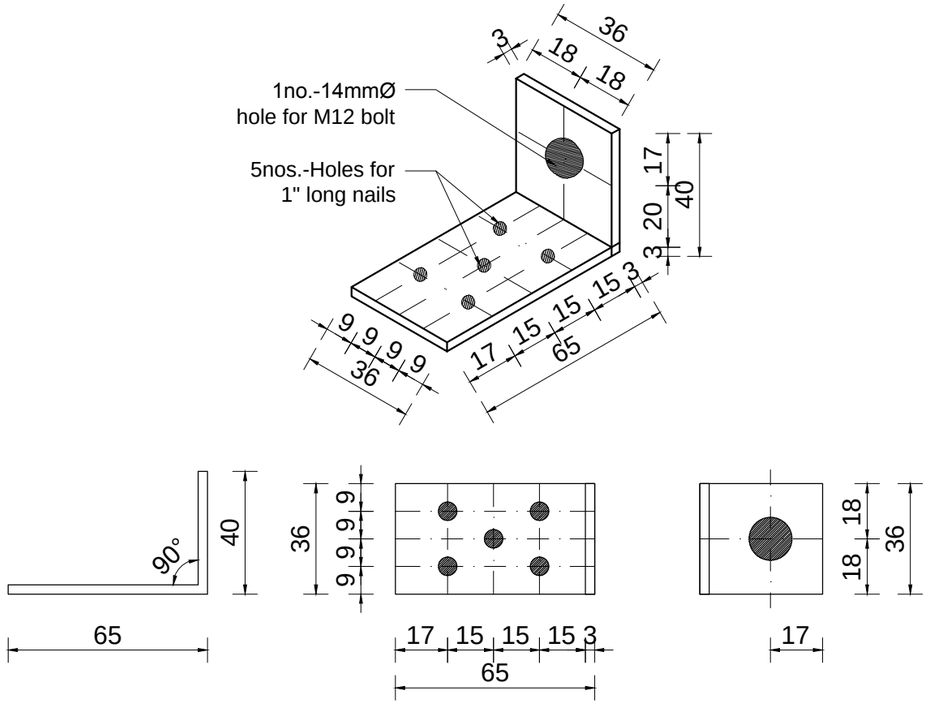
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

12

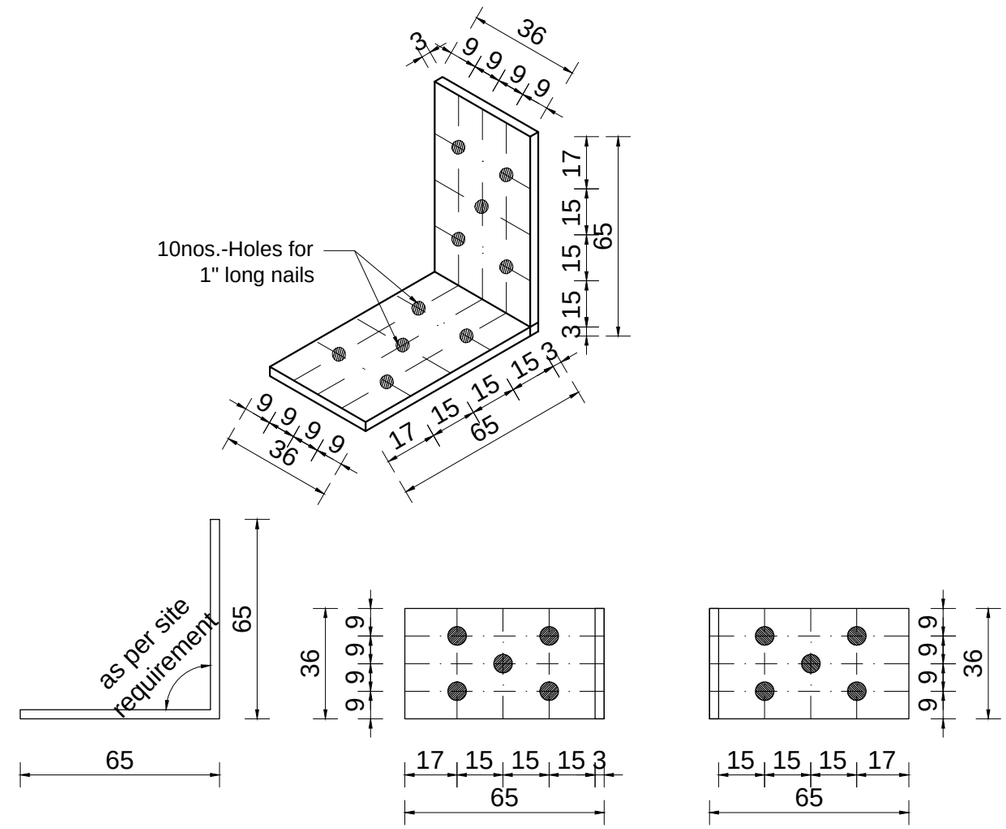
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017



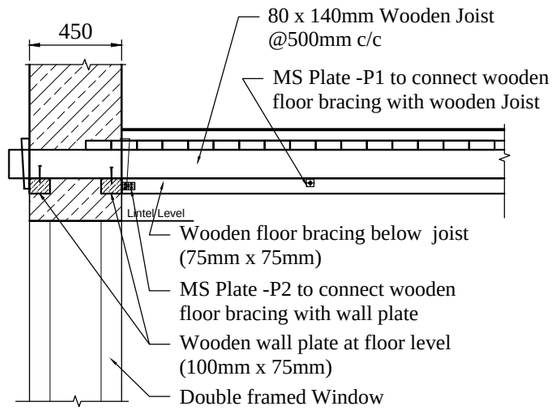
MS PLATE - P1

SCALE 1:2



MS PLATE - P2

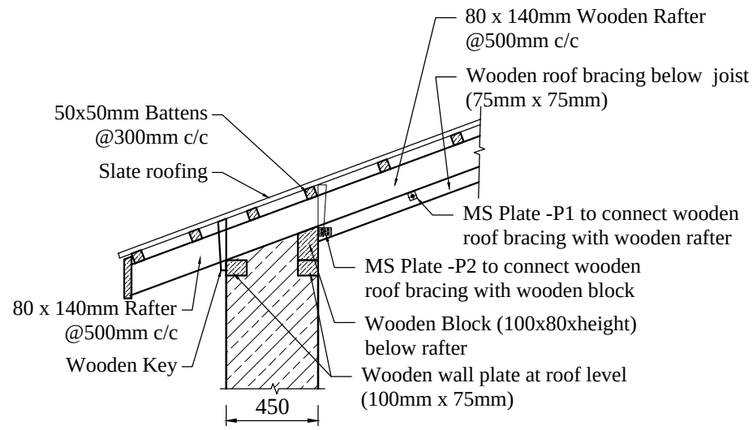
SCALE 1:2



DETAIL A1

SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL

SCALE = 1:30



DETAIL B1

SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL

SCALE = 1:30

PROJECT TITLE :-

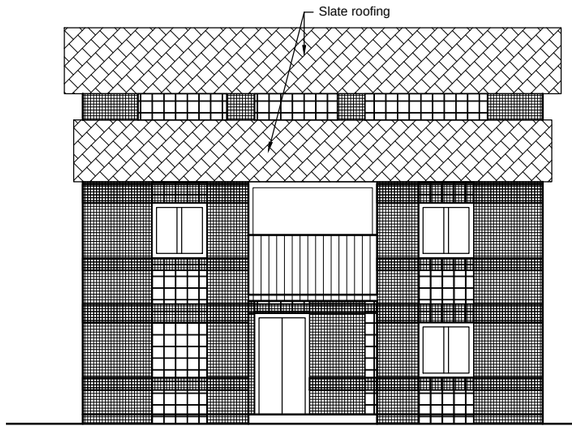
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

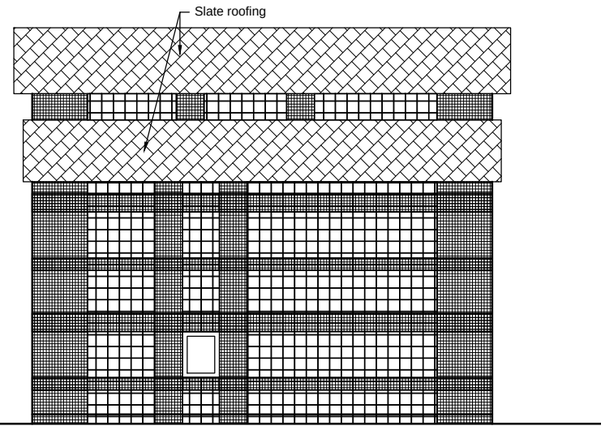
13

SCALE :- 1:30, 1:2 FOR A3 PAPER

DATE :- JULY, 2017

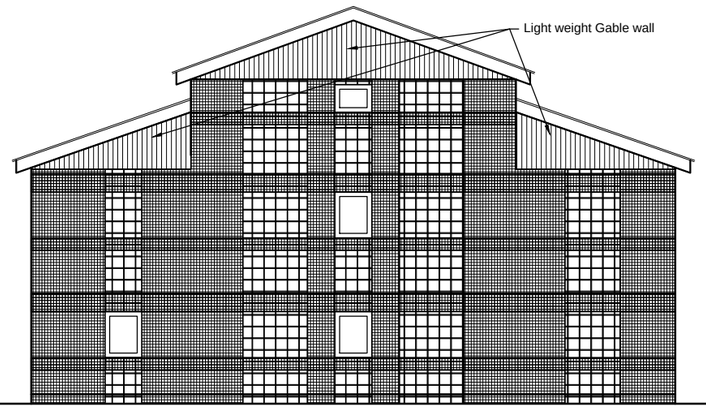


ELEVATION-1



ELEVATION-3

ELEVATION-2



ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING WITH G.I. WIRE MESH AND PP BAND

SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING AFTER RETROFIT

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

14

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN ON TWO STOREY STONE MASONRY BUILDING IN MUD USING TIMBER AND G.I. WIREMESH

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

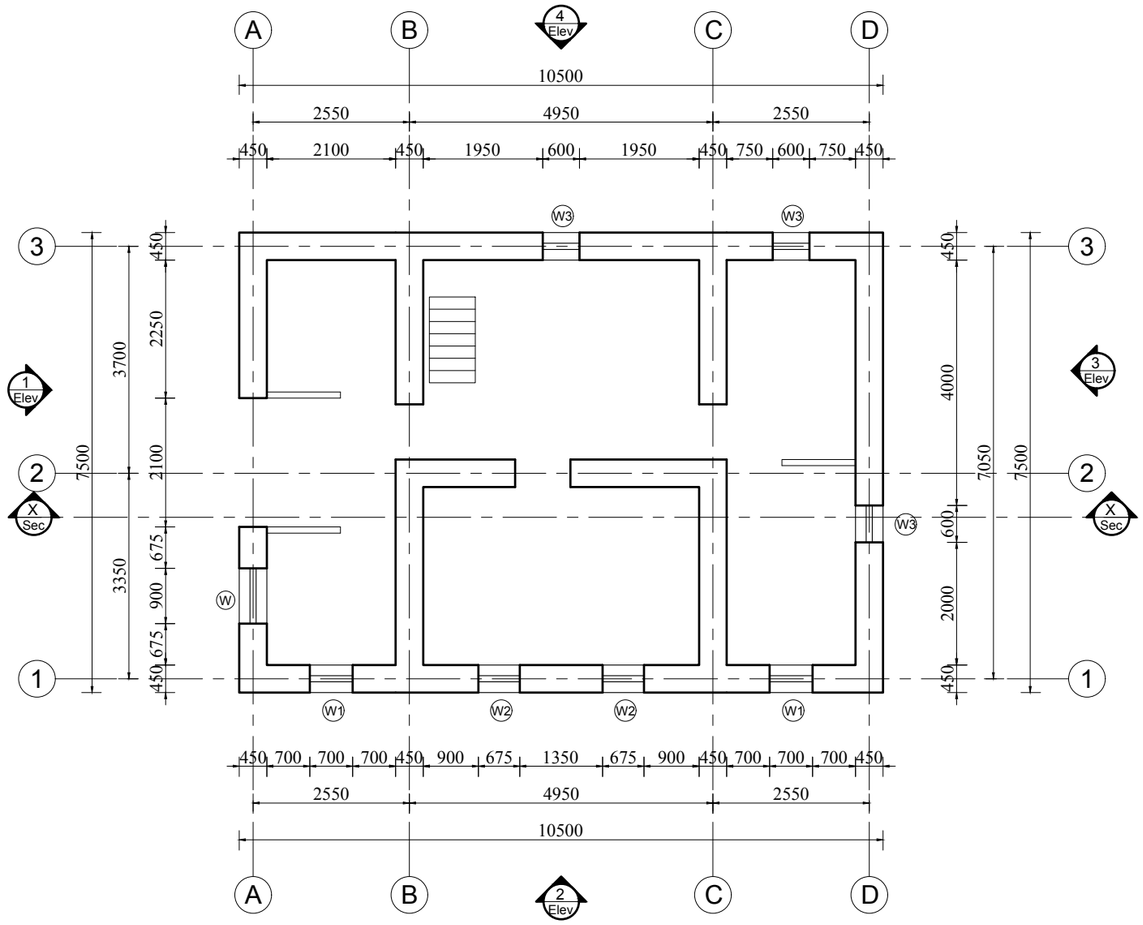
SHEET TITLE :-

COVER PAGE

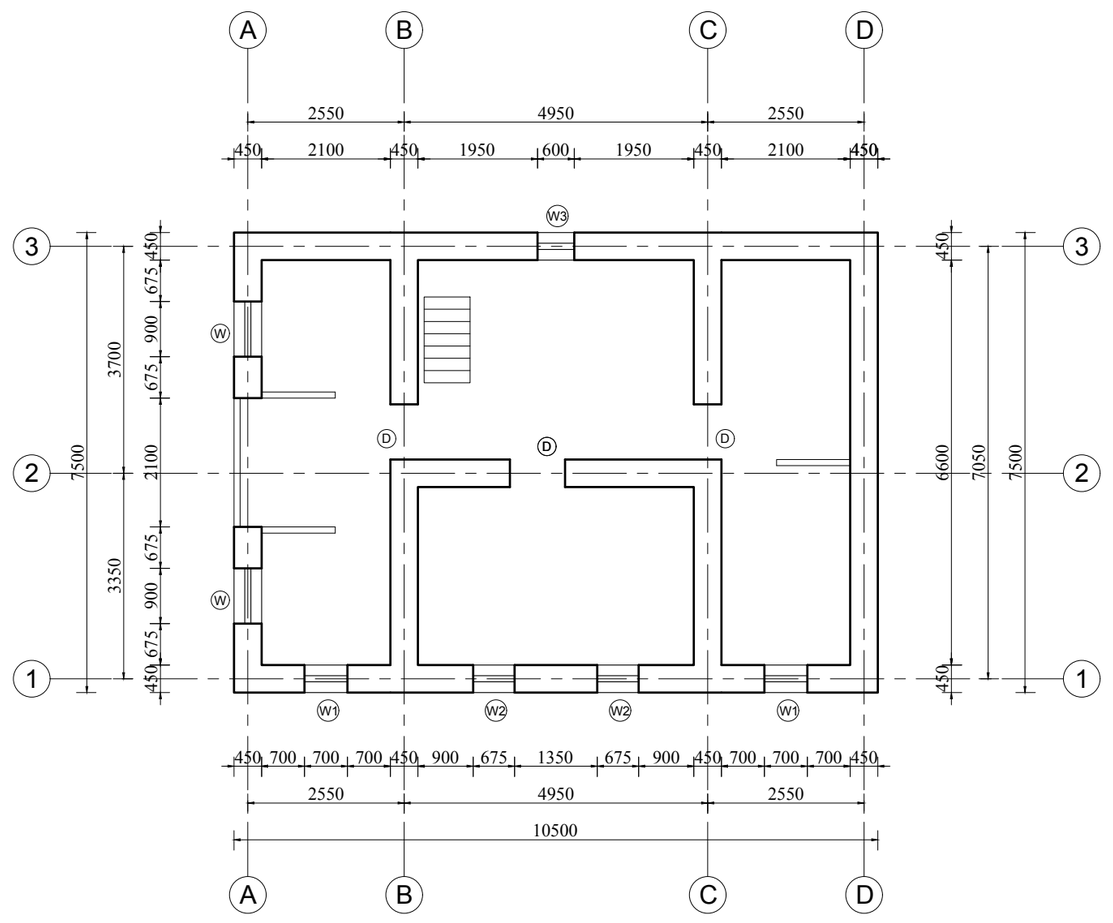
SCALE :- N/A

DATE :- JULY, 2017

0



GROUND FLOOR PLAN



FIRST FLOOR PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

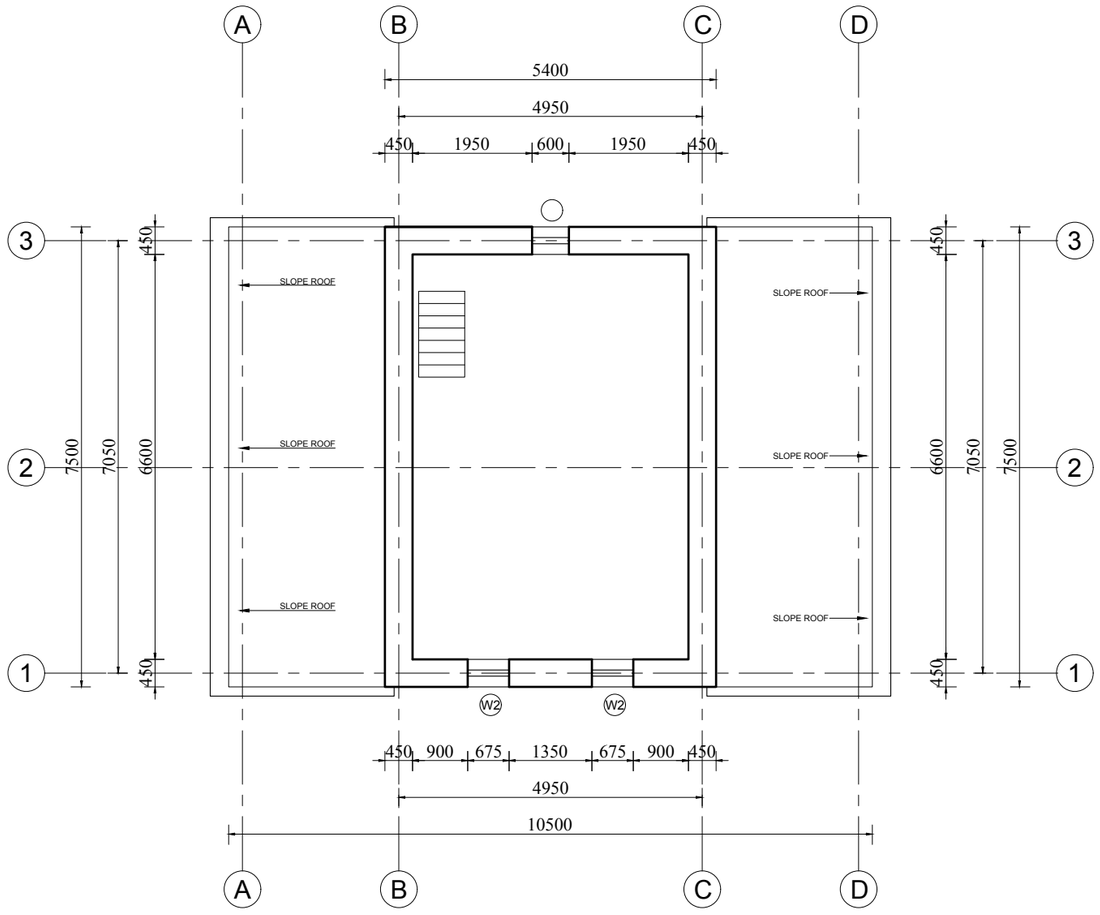
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

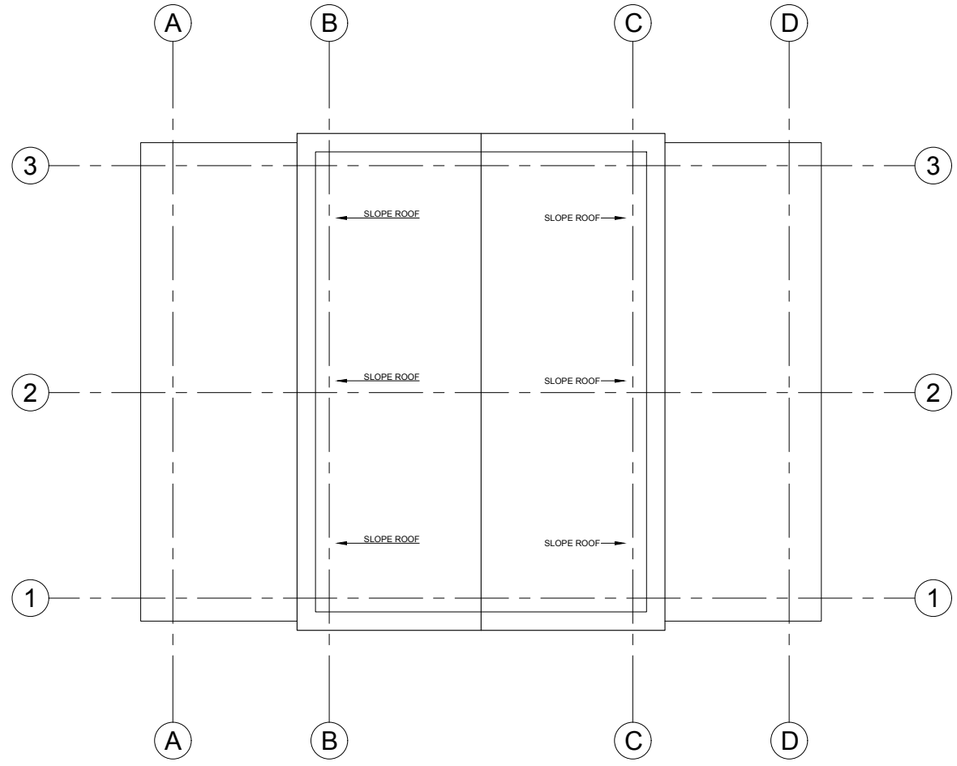
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

01



SECOND FLOOR PLAN



ROOF PLAN

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

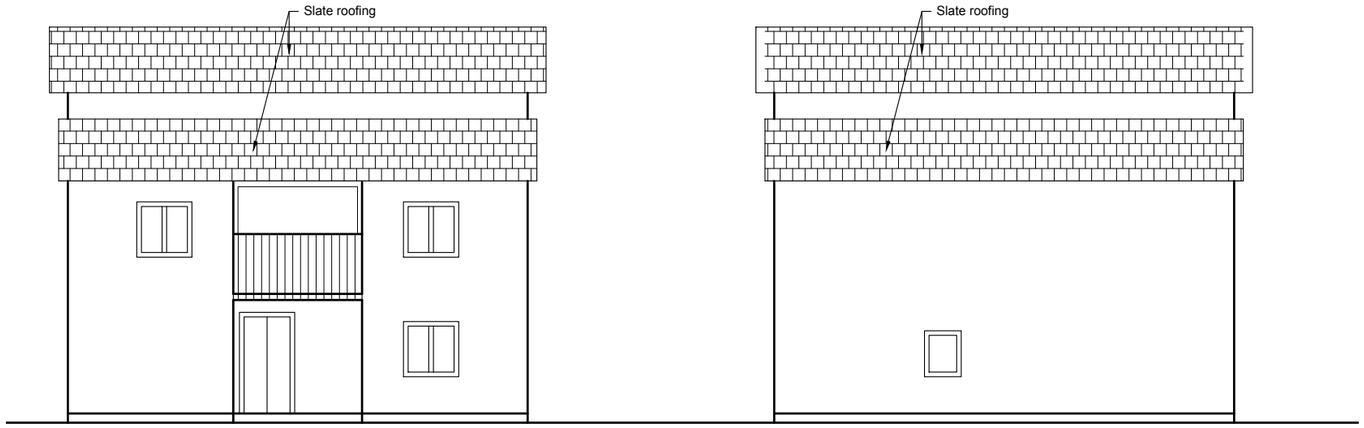
SHEET TITLE :-

FLOOR PLANS OF EXISTING BUILDING

SCALE :- 1:100 FOR A3 PAPER

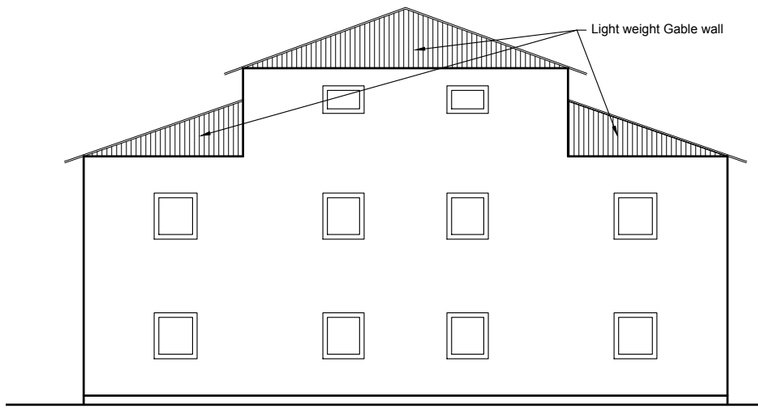
DATE :- JULY, 2017

02

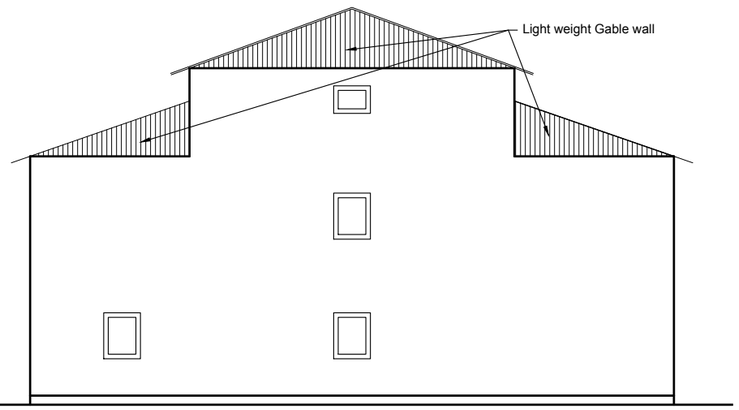


ELEVATION-1

ELEVATION-3



ELEVATION-2



ELEVATION-4

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

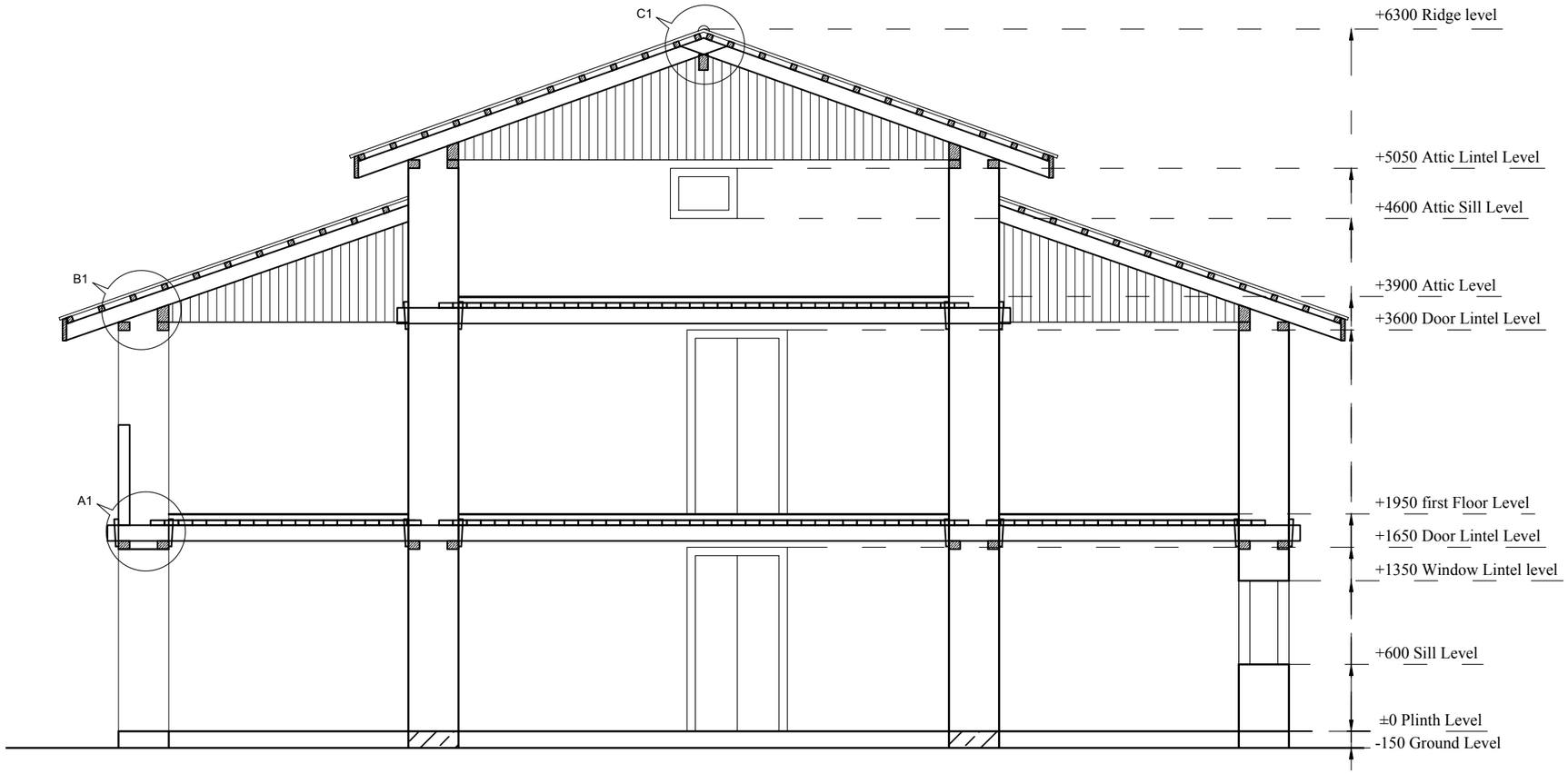
SHEET TITLE :-

ELEVATIONS OF EXISTING BUILDING

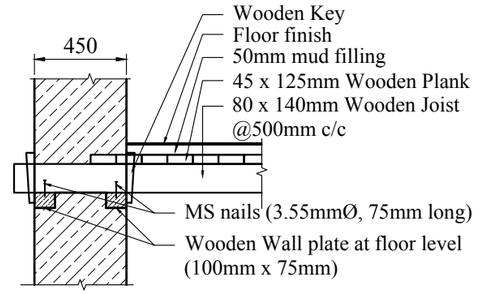
SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

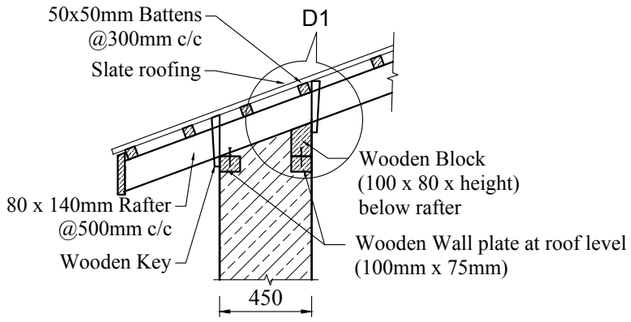
03



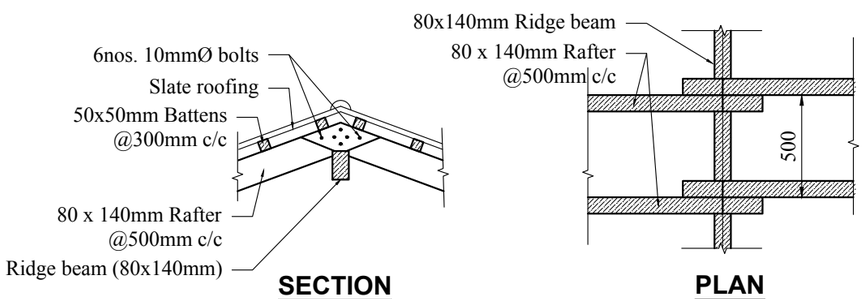
SECTION AT X-X
SCALE = 1:50



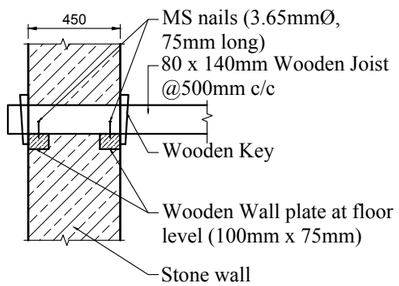
DETAIL A1
SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL
SCALE = 1:30



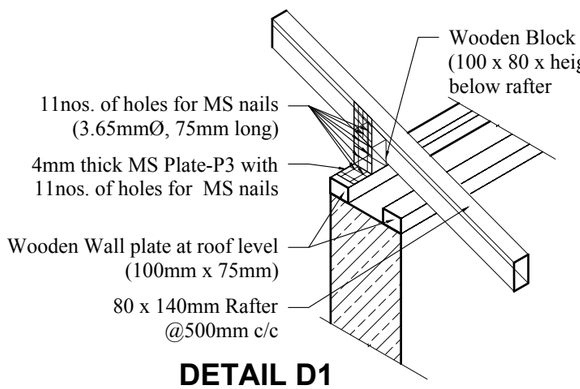
DETAIL B1
SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL
SCALE = 1:30



DETAIL C1
SHOWING ROOF DETAILS AT RIDGE LEVEL
SCALE = 1:30



FIXING OF JOISTS
SCALE = 1:30



DETAIL D1
SHOWING CONNECTION OF RAFTER WITH ROOF BAND
SCALE = 1:30

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

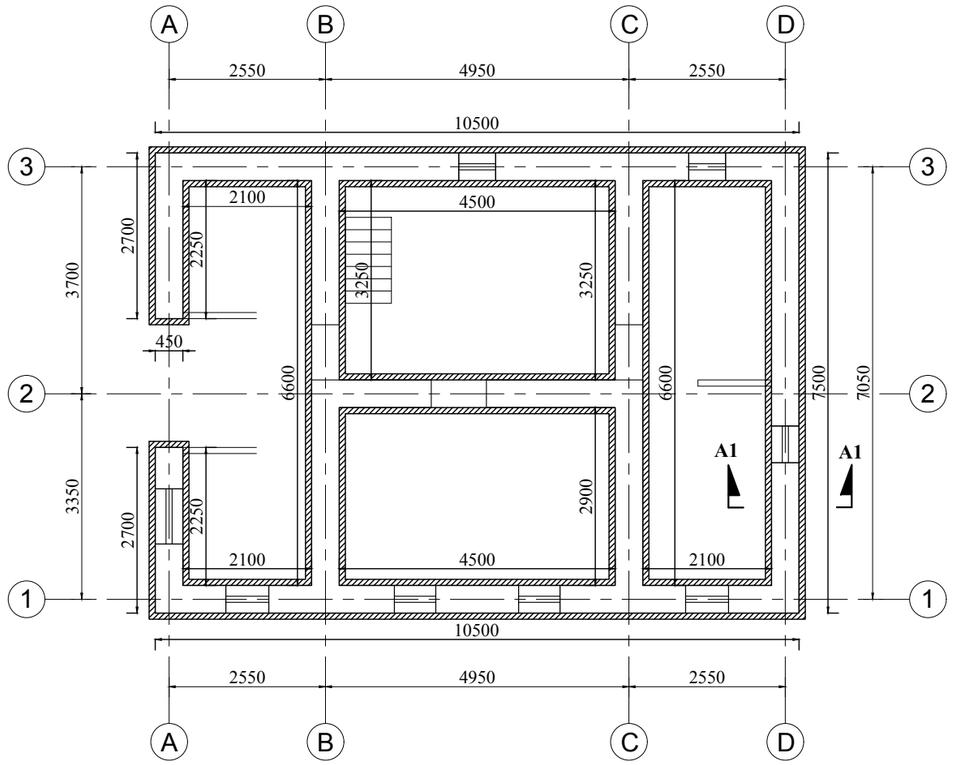
SHEET TITLE :-

SECTION OF EXISTING BUILDING AND DETAILS

SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

04

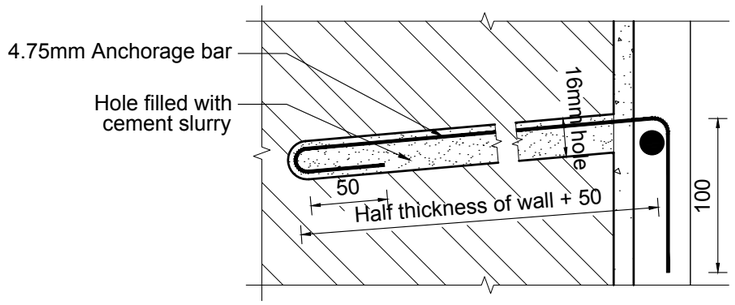


GROUND FLOOR PLAN SHOWING TIE BEAM FOR G.I. WIRE JACKETING

SCALE = 1:100

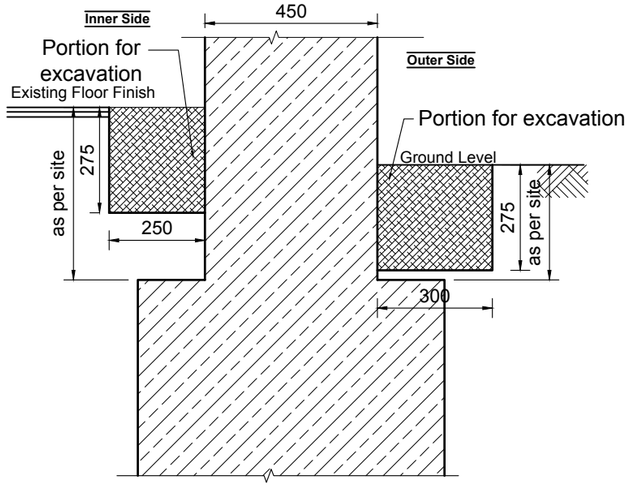
Notes:

Tie beam for Jacketing on walls using G.I. wire of 12SWG (2.64mm Ø) @ 150mm c/c both horizontally and vertically



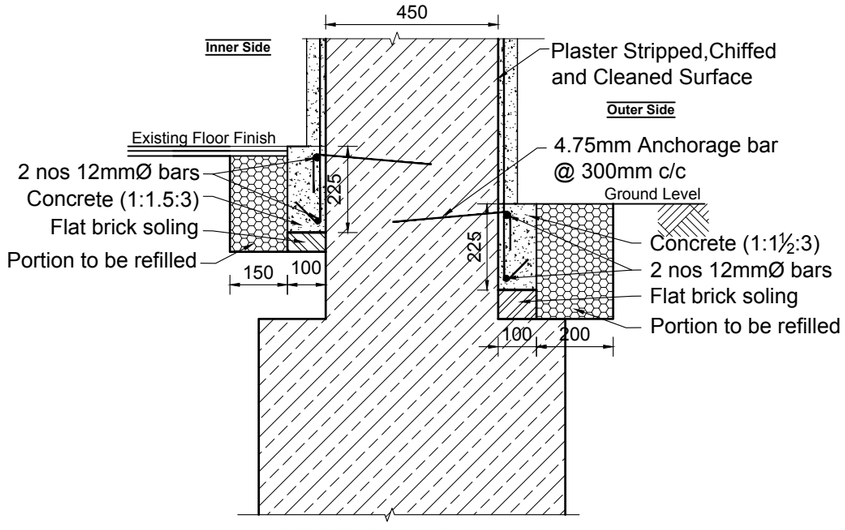
4.75 MM ANCHORAGE BAR DETAILS

SCALE 1:4



SECTION SHOWING THE PORTION TO BE EXCAVATED FOR TIE BEAM

SCALE = 1:16



SECTION AT A1-A1 SHOWING DETAILS OF TIE BEAM (FOR G.I. WIREMESH) FOR INNER AND OUTER SIDE OF THE WALL

SCALE = 1:16

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

SHEET TITLE :-

TIE BEAM AND DETAILS

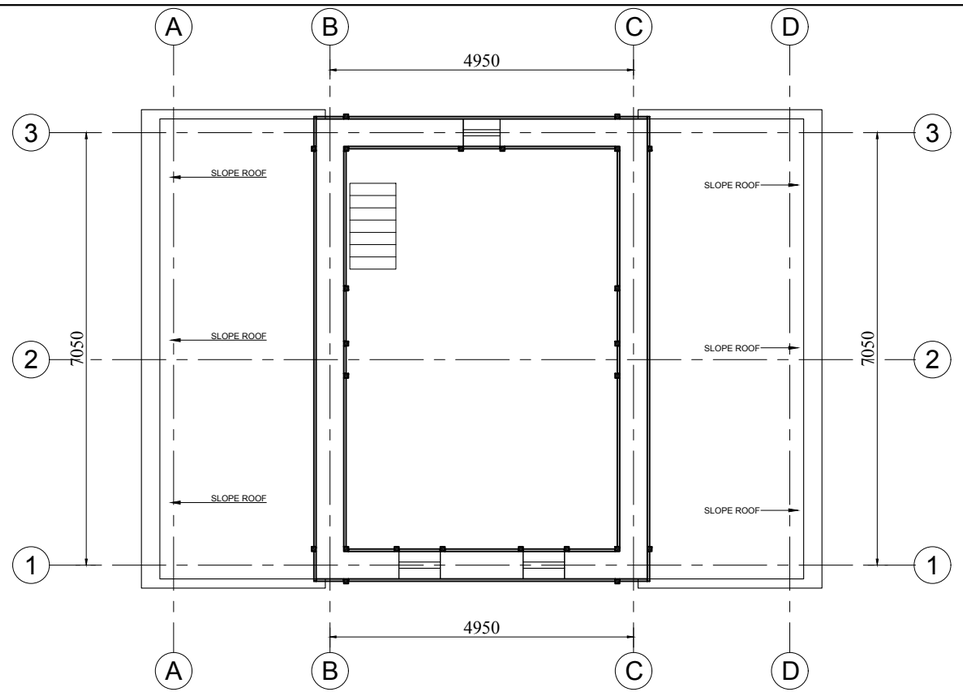
SCALE :- AS SHOWN FOR A3 PAPER

DATE :- JULY, 2017

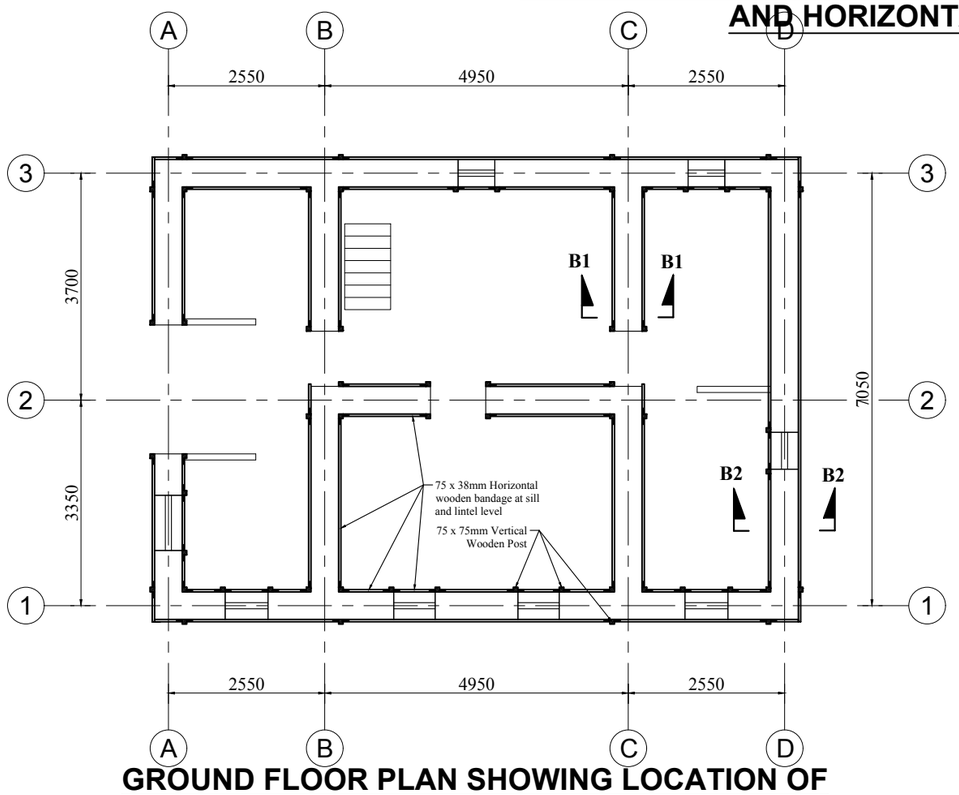
05

Notes:

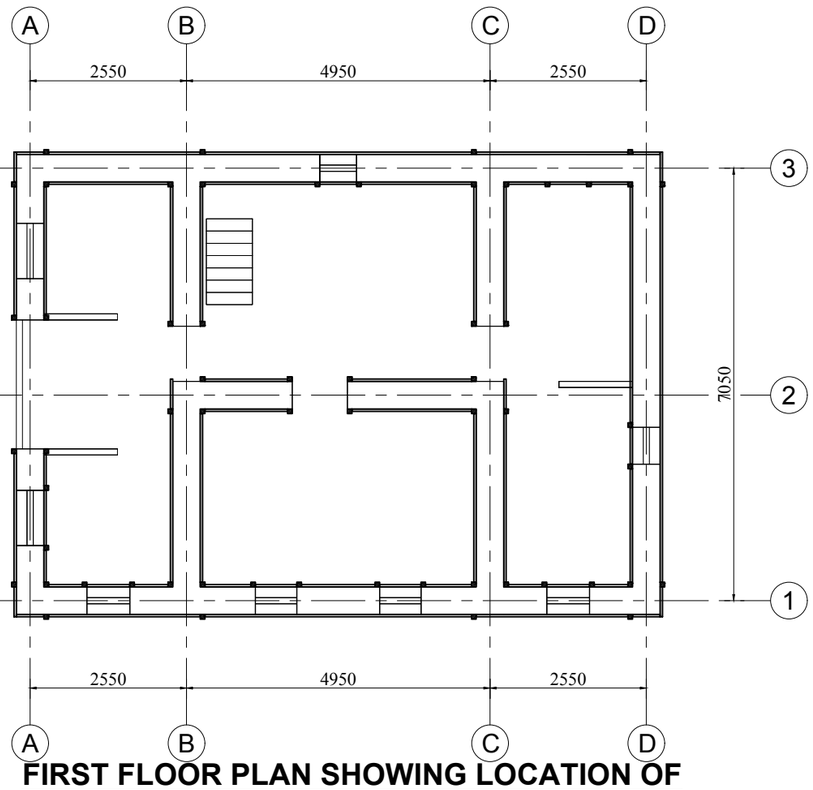
- Wooden Vertical Posts (75mm x 75mm)
- Jacketing on walls using G.I. wire of 12SWG (2.64mm Ø) @ 150mm c/c both horizontally and vertically



SECOND FLOOR PLAN SHOWING LOCATION OF VERTICAL POSTS AND HORIZONTAL BANDS ON WALLS



GROUND FLOOR PLAN SHOWING LOCATION OF VERTICAL POSTS AND HORIZONTAL BANDS ON WALLS



FIRST FLOOR PLAN SHOWING LOCATION OF VERTICAL POSTS AND HORIZONTAL BANDS ON WALLS

PROJECT TITLE :-

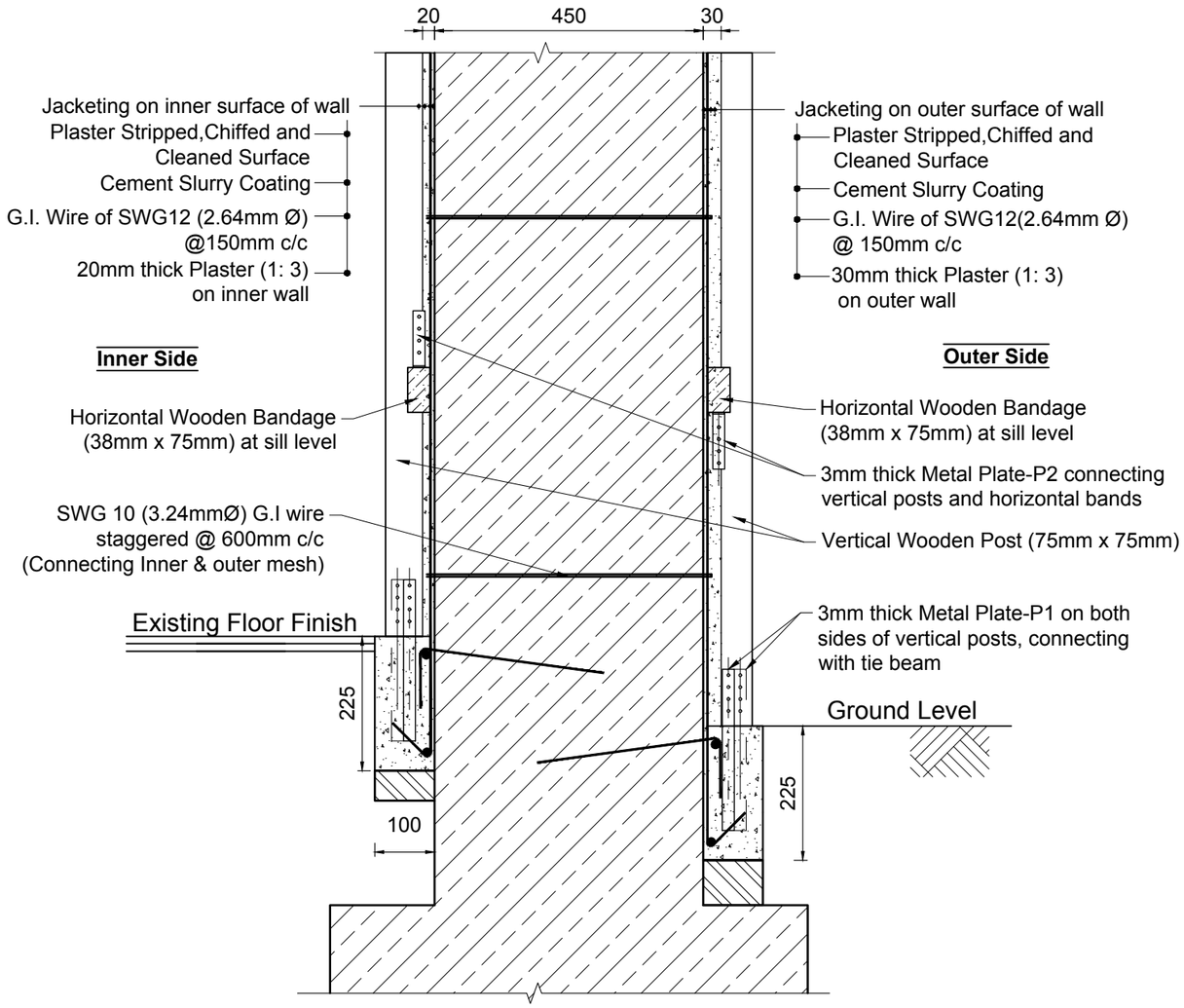
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

SHEET TITLE :- FLOOR PLANS SHOWING LOCATION OF WOODEN VERTICAL POSTS AND HORIZONTAL BANDAGE ON WALLS

SCALE :- 1:100 FOR A3 PAPER

DATE :- JULY, 2017

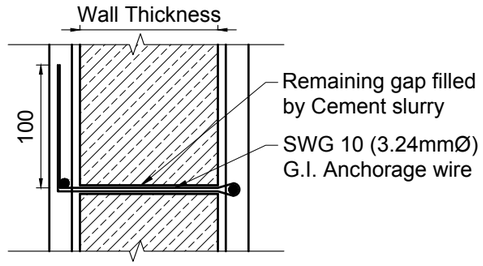
06



SECTION AT B2-B2

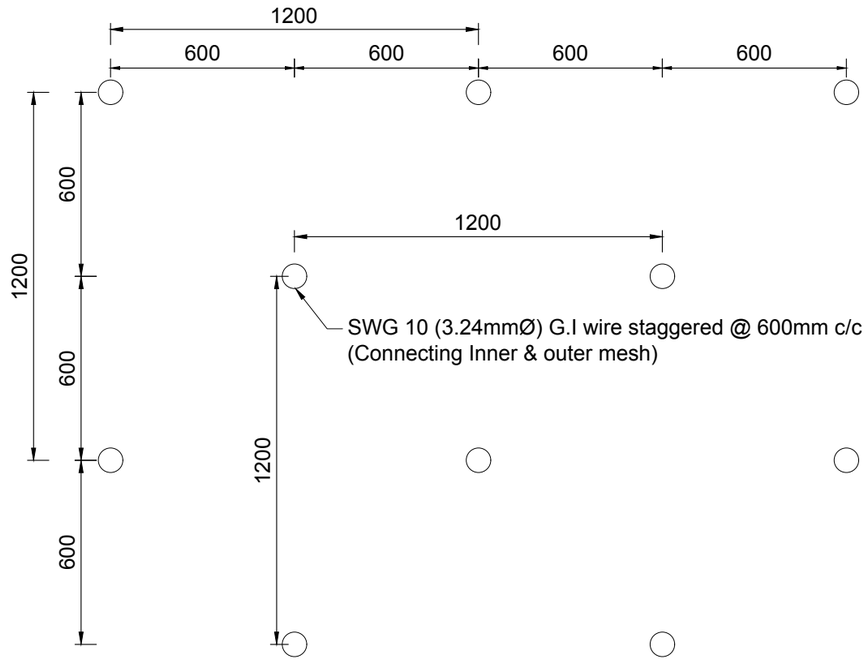
(DETAILS OF JACKETING ON BOTH SURFACES OF PERIPHERAL WALLS)

SCALE = 1:10



G.I. WIRE DETAILS

SCALE 1:10



LAYOUT OF G.I. WIRE ANCHORAGE FOR CONNECTING JACKETING MESH ON BOTH SIDES OF WALL

SCALE 1:20

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

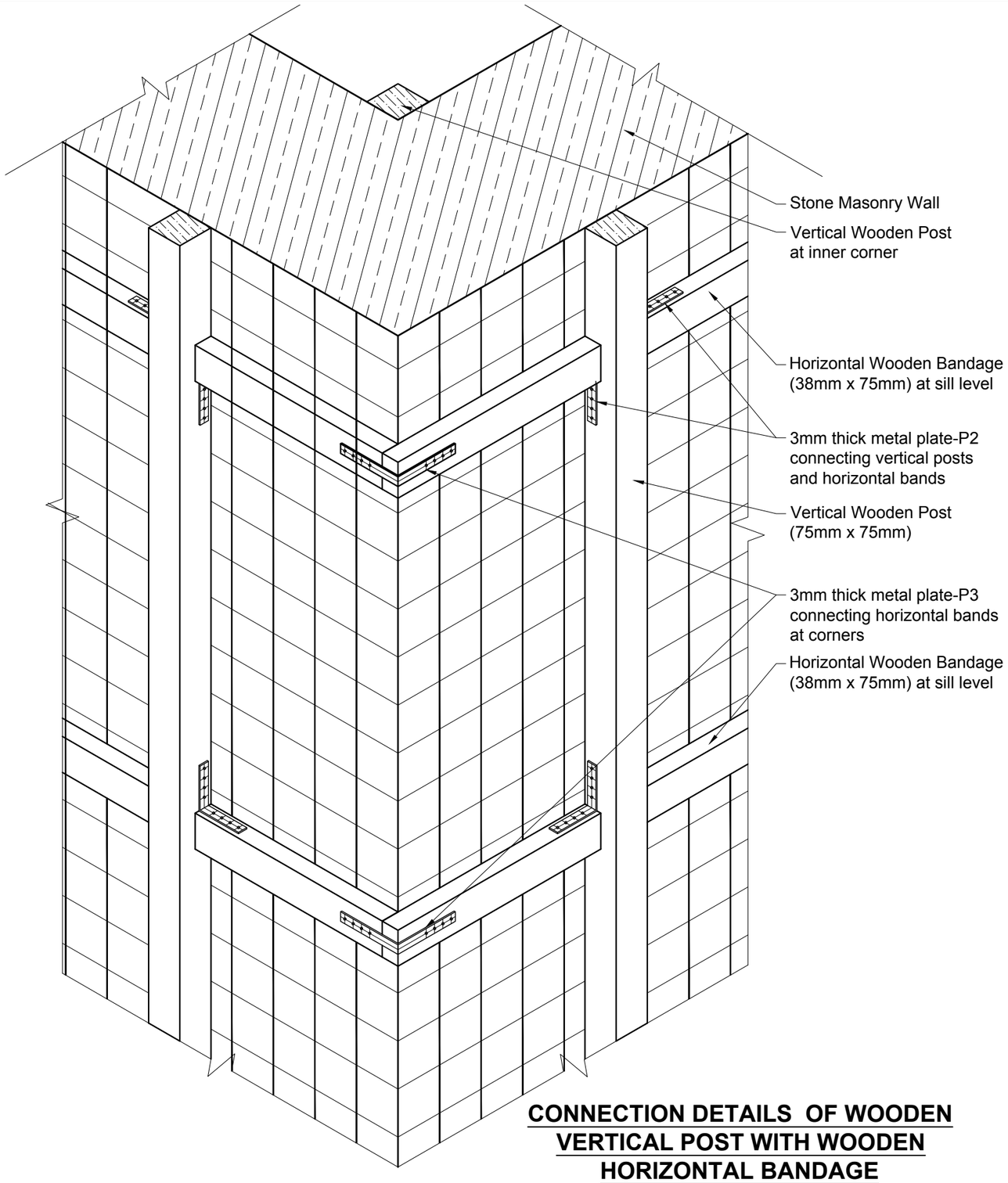
SHEET TITLE :-

DETAILS OF JACKETING ON WALLS

SCALE :- 1:20, 1:10 FOR A3 PAPER

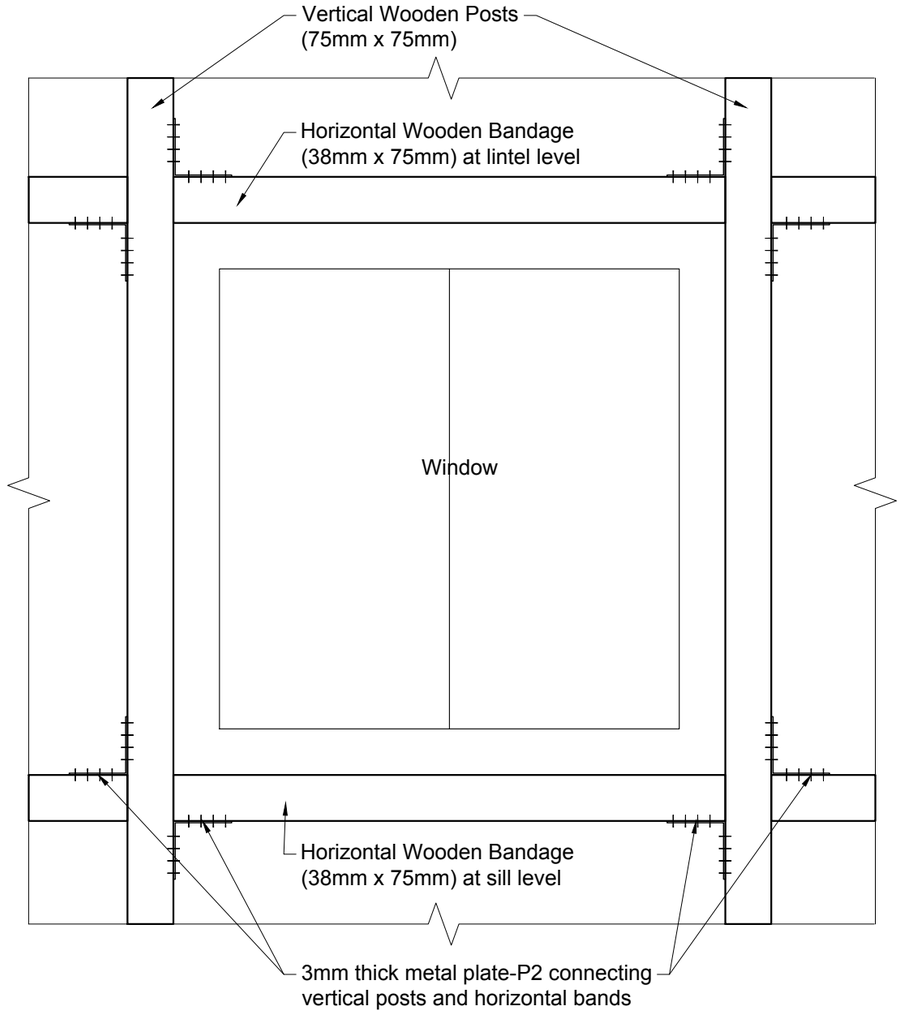
DATE :- JULY, 2017

07



CONNECTION DETAILS OF WOODEN VERTICAL POST WITH WOODEN HORIZONTAL BANDAGE

SCALE 1:10



CONNECTION DETAILS OF WOODEN VERTICAL POST WITH WOODEN HORIZONTAL BANDAGE

SCALE 1:10

PROJECT TITLE :-

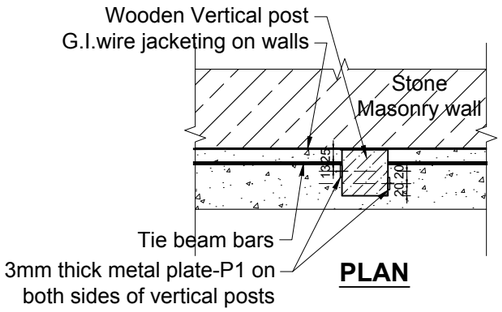
STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

SHEET TITLE :- DETAILS OFWOODEN VERTICAL POSTS AND HORIZONTAL BANDAGES

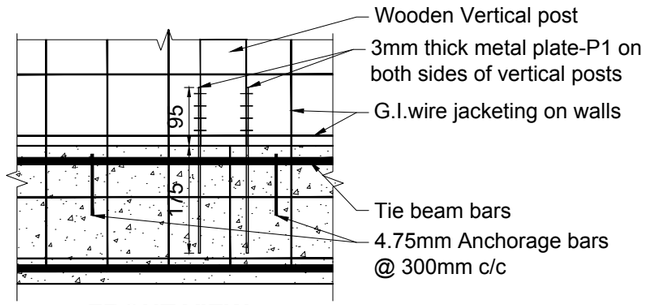
SCALE :- 1:10 FOR A3 PAPER

DATE :- JULY, 2017

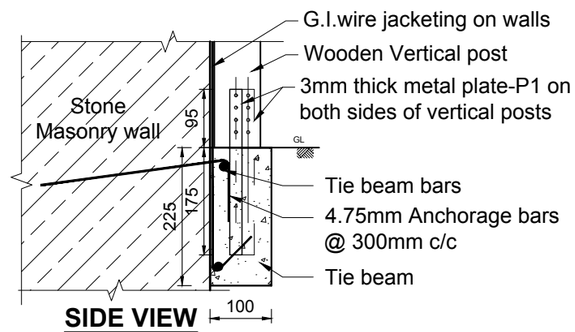
08



PLAN



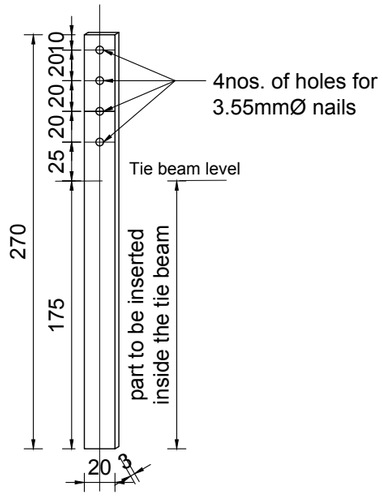
FRONT VIEW



SIDE VIEW

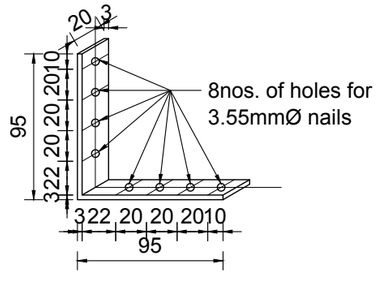
CONNECTION DETAILS OF WOODEN VERTICAL POST WITH TIE BEAM

SCALE 1:10



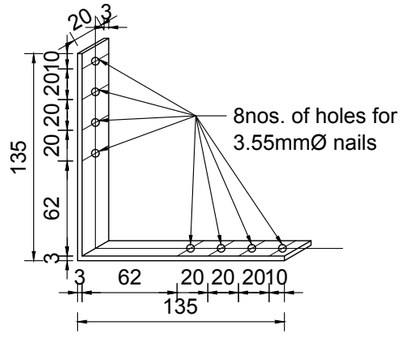
METAL PLATE-P1

SCALE 1:4



METAL PLATE-P2

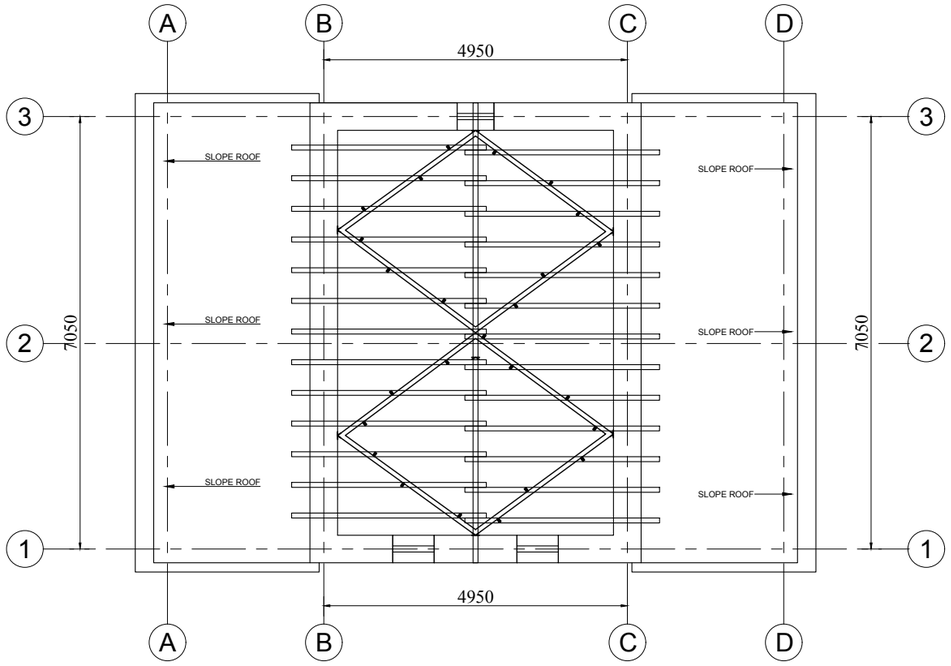
SCALE 1:4



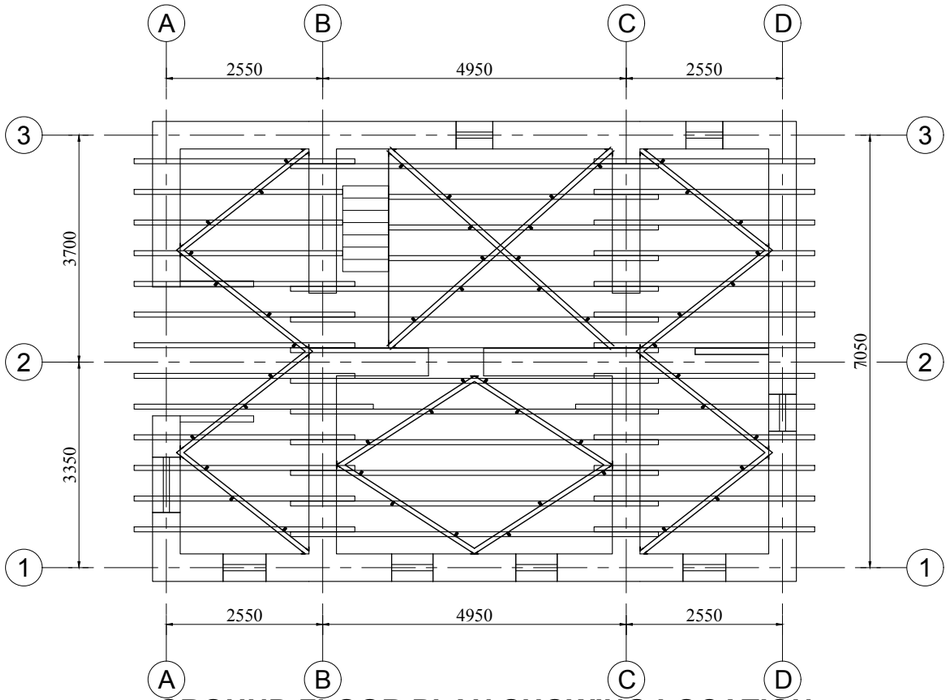
METAL PLATE-P3

SCALE 1:4

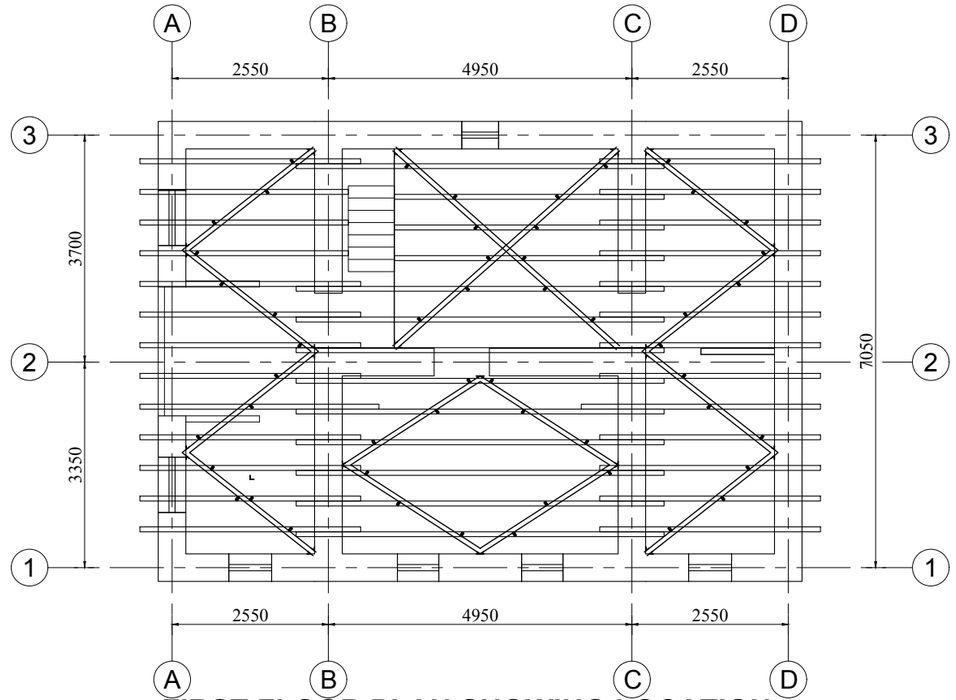
PROJECT TITLE :- STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH	SHEET TITLE :- DETAILS OF WOODEN VERTICAL POSTS AND HORIZONTAL BANDAGES	09
	SCALE :- 1:10, 1:4 FOR A3 PAPER / DATE :- JULY, 2017	



SECOND FLOOR PLAN SHOWING LOCATION OF HORIZONTAL BANDAGE ON WALLS



GROUND FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF



FIRST FLOOR PLAN SHOWING LOCATION OF BRACING ON FLOOR AND ROOF

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

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SCALE :- 1:100 FOR A3 PAPER

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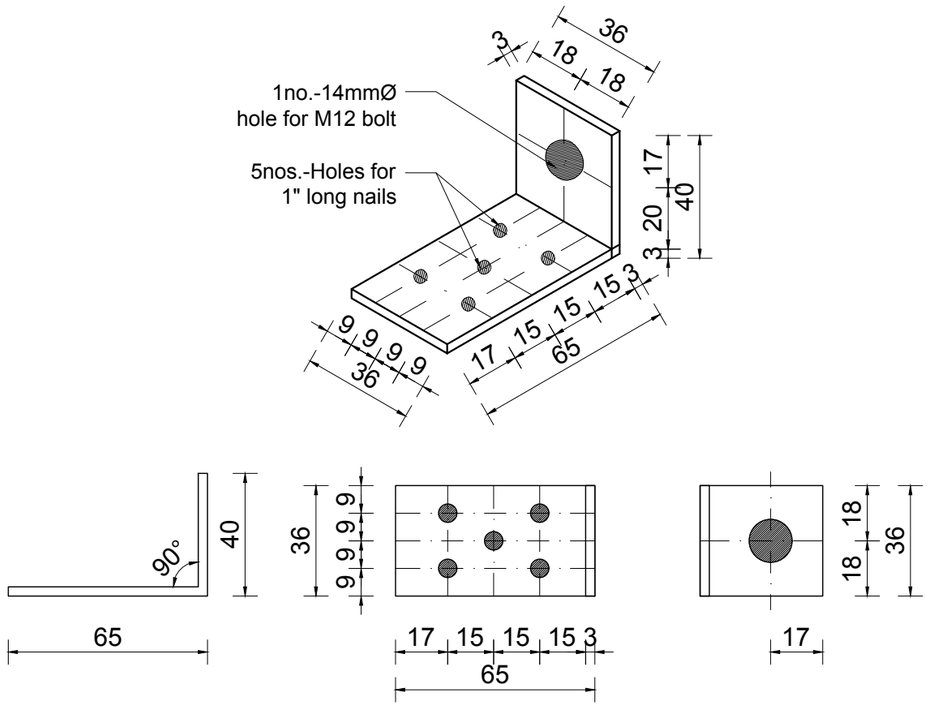
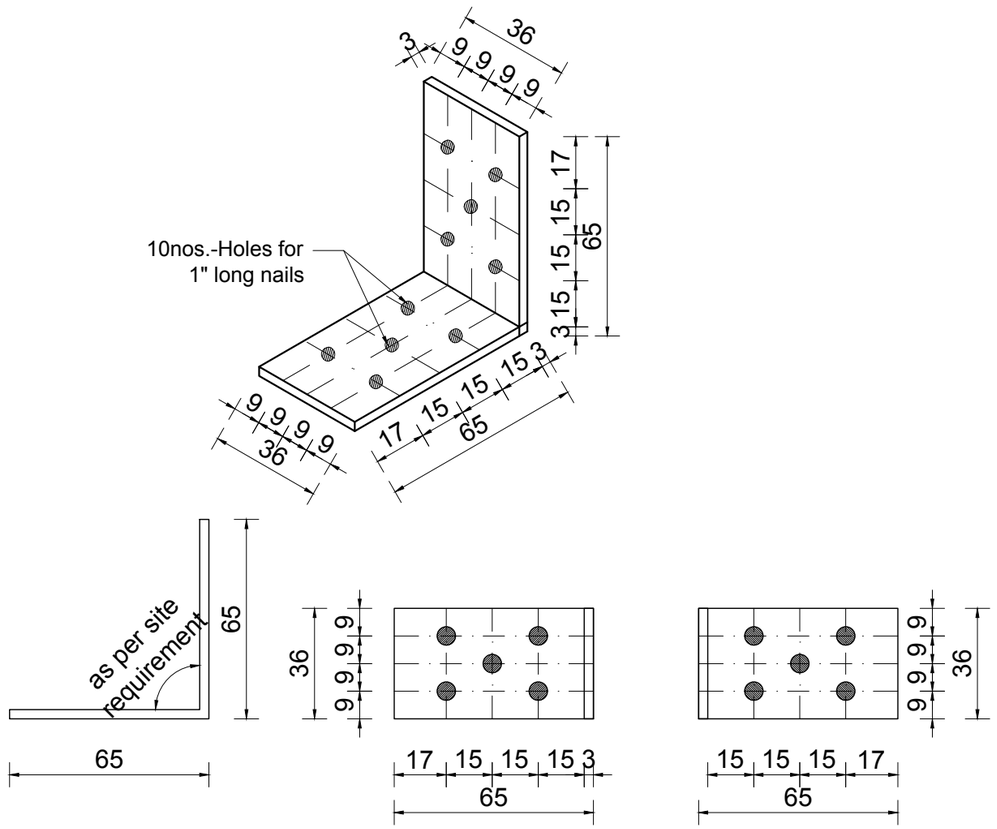


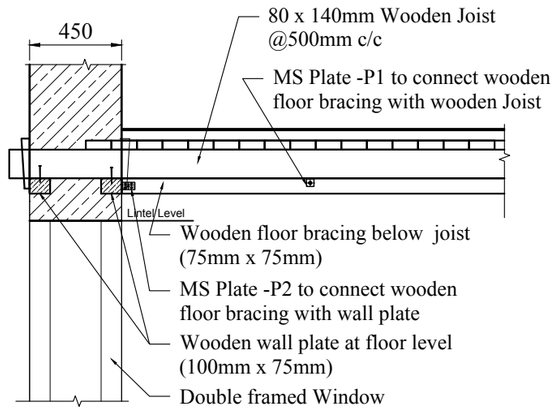
MS PLATE - P1

SCALE 1:2



MS PLATE - P2

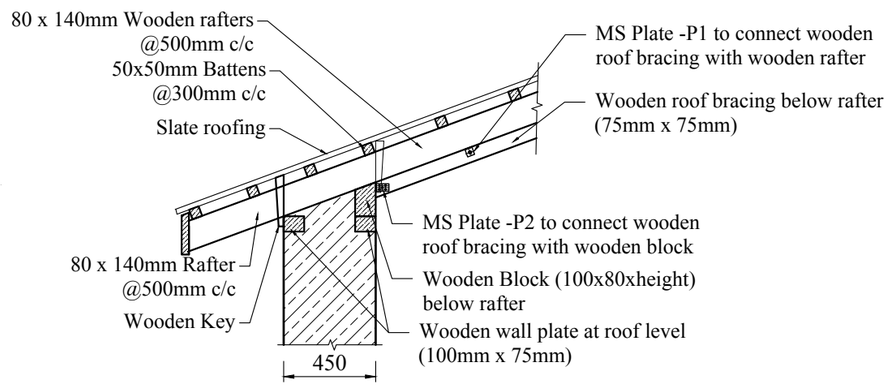
SCALE 1:2



DETAIL A1

SHOWING CONNECTION OF FLOORING MEMBERS WITH WALL

SCALE = 1:30



DETAIL B1

SHOWING CONNECTION OF ROOFING MEMBERS WITH WALL

SCALE = 1:30

PROJECT TITLE :-

STRUCTURAL DRAWINGS FOR RETROFIT DESIGN OF TWO STOREY LOW STRENGTH STONE MASONRY BUILDING USING TIMBER AND G.I. WIRE MESH

SHEET TITLE :- FLOOR PLANS SHOWING LOCATIONS OF HORIZONTAL AND INCLINED BRACING AT FLOOR AND ROOF LEVEL

SCALE :- 1:30, 1:2 FOR A3 PAPER

DATE :- JULY, 2017

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